ENGINEERING NEWS

THE engineers of the proposed Nicaragua canal arrived at Greytown on December 9, and were met by a welcoming commission appointed by the Nicaraguan Government, and cordially received. Mr. PEARY, the engineer in charge, has already issued his instructions to the chiefs of parties. From these we see that the route is to be permanently monumented; streams cross-sectioned and velocity measured; a field map, on a scale of 400 ft. to the inch, made by each party; borings to be made to the plane of the canal bottom along the route, whenever possible, etc. Great attention is also paid in these instructions to all that pertains to the good health of the various parties.

The assignment of engineers to the several parties with the section of the route to be surveyed by each, is given in the N. Y. *Times* as follows:

Hydrographic party, to begin operations at the harbor of Greytown—Lieut. W. J. Maxwell, chief; Macdonough Craven, first assistant; D. B. Macauley, recorder; Paul M. Cooke, rodman; H. D. Murphy, draughtsman; John Kirk, leadsman. Boring party, to commence work at the dam—E. W. Hunt in charge. Surveying parties: No. 1, operating from Lock No. 2 to the San Juanillo—J. W. Pethard, chief; H. C. Miller, first assistant; Ricardo Molina, second assistant; Paul Spicer, rodman; George B. Stratton, chainman. No. 2, at the divide from the Saltos de Elvira to Lock No. 2—Frank P. Davis, chief; W. V. Alford, first assistant; A. J. Menocal, second assistant; P. V. R. Van Wyck, rodman; John M. Murphy, chainman. No. 3, at the embankment—Domingo Garcia Cartaya, chief; J. G. Holcombe, first assistant; H. C. Litchfield, second assistant; Emil Diebitsch, rodman; Louis William Mohun, chainman. No. 4, at the head of the San Francisco—Garnett Savage, chief; F. T. Bernhard, first assistant; Calixto Guiteras, second assistant; William M. McCawley, rodman; R. J. Wilson, chainman. No. 5, at the dam—J. F. Perez, chief; P. H. Bevier, first assistant; F. W. Bennett, second assistant; Perry Fuller, rodman; Henry W. Johnson, chainman. Mr. Peary also designated J. Francis Le Baron to be his immediate assistant and, in case of accident or temporary disability to himself, to take charge until he should be able to resume control.

Mr. H. C. LOWRIE, City Engineer of Denver, Col., has devised and patented a new cable conduit and slot-covering. The cable is put in a solid shell of cast-iron, 7 in. deep by 2¼ in. wide inside. This conduit is flanged at the bottom and spiked or bolted to iron or wooden cross-ties. The carrying pulleys are in sunken impervious frames and near enough together to prevent the cable from striking the bottom of the conduit. The slot in the top of the conduit is 2½ in. wide, but this is closed by a continuous, chain-like cover with bevelled sides fitted to a bevelled seat in the top of the conduit. This chain is rigid laterally. Attached to the grip-shank on the car are plow-points, front and back. These points, introduced at one end of the cable or by a temporary disconnection at any point, pick up the cover chains, pass it through an aperture in the shank and lay it down again. The cover is raised only 2 in. at the extreme point and while raised is everywhere inclosed by the carrying frame. The plow points also plane off all obstructing material on the cover before lifting it, and clear the top and sides again before relaying it, so that ice and snow are claimed to be no obstructions to its use. The machine is said to plow through a foot of snow without letting any of the snow into the conduit. The inventor claims a reduction of one-half in the cost of track and conduit.

WE rejoice to learn that Mr. GEORGE WESTINGHOUSE, Jr., has secured a patent on a new arrangement for braking all the wheels on a six-wheeled truck. Heretofore brakes have been so constructed as to only allow brake-shoes to work on the outside wheels of these trucks, the middle wheels having no brakes, so that by the new device the braking power is increased one-third. The arrangement has been tried by Mr. WESTINGHOUSE and given perfect satisfaction. It should go into use at once, failing some still better device. The lack of it has caused many accidents and aggravated more.

ACCORDING to the Chicago papers, Messrs ONDERDONK & Co., the contractors for the new Lake tunnel, with Mr. HALL, of the Calumet Iron & Steel Works, as Superintendent, are preparing to use a steel shield in tunneling through the clay. This shield, as described, is substantially the same as that now being used in the Tower subway under the Thames in London and illustrated in our issue of Nov. 5 last. It would be a steel ring 10 ft. long and 10 ft. 2 in. in diameter, with a cutting edge of ½ in. steel. About 13 in. from the front edge would be an angle of iron against which would push a series of four rams of "300 ton" power each, worked by air compressed to 800 lbs. to the sq. in. These rams when acting would abut against the finished brick masonry ring. To remove the debris a double-track 2½ ft. gauge railway will be laid, operated by a small locomotive, 6×8 ft., with "drop-tube boilers" and double engines. Each car will hold 1 cu. yd. and 10 cars will make a train. The shaft elevator will hold four of these cars.

THE shore shaft of this new Lake tunnel at Chicago is down 23 ft. below the surface, at last accounts. With this shaft is being sunk an iron shell 13 ft. in diameter carrying, on a projection of the cutting edge, the brick lining. There has been some growling about pay, but the evidence shows that as yet "miners" are not wanted, and for laborers' work the contractors properly object to paying more than laborers wages, that is $2.50 per day. When the foot of the shaft is reached, 92 ft. down, and the drives under the lake and to the pumping station commenced, the pay will be $3.50 to $3.75 per day. The amount promised masons is $6 per day.

THE Minnesota & Northern tunnel at Aiken, Ill., which has just been completed is 2,442 ft. in length instead of 3,460 ft., as stated in last weeks issue. The original error in the press reports was overshadowed by the substitution of a 3 for a 2 in the first place. The above figures are from Mr. H. FERNSTROM, Chief Engineer of the Chicago, St. Paul & Kansas City system, who further states that the tunnel is now completely timbered and ready for tracklaying, and that it will be lined with brick in the near future.

THE executive committee of the Illinois River Improvement Convention is again pushing the subject of a ship-canal between the Mississippi river and Lake Michigan by way of the Illinois and Desplaine rivers. A bill is to be presented to Congress forming a commission, of 5 members, to be called the Lakes and Gulf Waterway Commission. Two of this commission are to be selected from the U. S. Engineer Corps and three from civil life, one of the latter to be a civil engineer. This commission is to direct and complete surveys, etc., for a waterway capable of discharging 600,000 cu. ft. of water per minute from the lakes.

THE latest KRUPP contract with the Italian Government is for four 119-ton guns; three of these have been accepted, and the fourth gun has just been tested at the KRUPP works. The 80th round was fired with a projectile weighing 2,315 lbs. and 847 lbs. of powder. The muzzle velocity was 1,900 ft. per second, and the muzzle energy was 57,933 foot-tons. According to KRUPP's formulæ this would give a penetration of 39.4 in. into iron at 1,094 yds., or 29.55 in. into compound armor or steel. The calibre of these guns is 15¾ in. This record of muzzle energy, or smashing effect, is the greatest yet made by any gun.

THE struggle between the gunmakers and the platemakers is still going on, and while ships are now afloat with 21.67 in. of armor, the two new warships which Italy is building, are to have 29 in. plates.

ON Jan. 11 an engine and 3 cars went through a trestle on the Chester & Lenoir Railroad at Hickory, N. C. The wreck caught fire and was burned. Three persons were injured.

ON Jan. 5 a serious accident due to carelessness happened to the iron viaduct at Cleveland, O. This viaduct is to connect the east and west sides of the city, will be about a mile long, and will cost about $2,000,000. It has been under construction for 2 years. The span over Central way was being erected and a traveler was in use, resting on the completed portion. The false-work gave way while the traveler was hoisting a girder, and the span and traveler fell to the road below. Two men were killed and 4 injured. The City Engineer reported at the inquest that the design was good and the iron of good quality. The loss is estimated at about $10,000. The King Iron Bridge & Manufacturing Co. had the contract.

Indian Engineering announces that a remarkable engineering feat has just been carried out in China in the face of unusual physical obstacles. This was the stretching of a steel cable of seven strands across the Luan river by Mr. A. de LINDE, a Danish civil engineer, aided only by unskilled Chinese labor. The cable is strung from two points 4,648 ft. apart. The height of one support is 447 ft. above the present level of the river and the second support 737 ft. above it. The vertex over the water is 78 ft. The Chinese cable is the longest but one in the world. The telegraph air cable across the Kistna has a span of 5,070 ft; two similar cables across the Ganges, one 2,900, and the other 2,830 ft. A third line of 1,135 ft. crosses the Hooghly, and in the United States there is one over the Missouri of 2,000.

Mr. WHARTON BARKER, of the Chinese-American railway and banking syndicate, has not gone to China as reported. Count MITKIEWICZ and a party of Americans interested sailed on Nov. 12, with the Chinese envoy.

IT is said that the Park Department and the new York Central R. R. Co. have finally come to an agreement concerning the depression of the Harlem R. R. tracks in this city. The estimated cost of the contemplated improvement is put down at $2,000,000 to be entirely paid by the railroad company. Work is to be commenced about Feb. 1. The track is to be depressed about 10 ft. from 138th. St. to Woodlawn and over it 38 bridges are to be built.

IN the U. S. Senate alone bills have been introduced during the present session appropriating more than $10,000,000 for public buildings.

THE old scheme of building a canal around Niagara Falls has been revived in the present Congress. The estimated cost is $10,000,000 or $12,000,000; but the Western New York members will vigorously oppose it as usual. This project actually passed the House as long ago as 1862-63 but failed to become a law.

Messrs. HALL & DUFUR, of Oil City, Pa., are reported as erecting a plant at St. Paul, Minn., for the manufacture of illuminating gas from petroleum. They expect to obtain 1,000 cu. ft. of gas from 6 galls. of oil. The Midvale Steel Works and the Baldwin Locomotive Works are also said to be erecting plants for the manufacture of gas, from Ohio oil, for industrial purposes.

THE accident on the Manhattan Elevated which we noted last week was quickly followed by two others of similar character as respects results, although different as to cause. A pay car was split on a switch at Chatham Square by the switchman throwing a switch too soon, the front truck going one way and the rear the other, causing considerable delay but little damage, and another more serious one was at 60th. St., and 9th Av., where a train jumped the uptown track, and but for the middle track would have fallen to the street. As it was, the cars crossed the middle track to the down-town track and blockaded the road for more than half an hour.

The train was packed with passengers and there was a good deal of excitement for a few minutes, but no one was injured. The elevated is unfortunate in having all its accidents occur in the heart of a great city where they are sure to be noted, but yet they have a certain significance as to the consequences of overcrowding travel too much.

THE very serious accident at Haverhill, Mass., which we fully describe elsewhere, was by far the most serious of the week and certainly the most instructive. There has been a long list of others however, notably in the Rocky Mountain region.

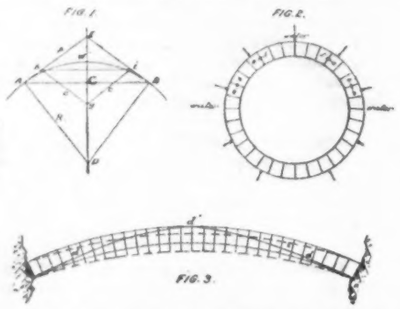
The Theory of High Masonry Dam Construction.

We reprint below the entire report of Chief Engineer CHURCH on the design of the Quaker Bridge dam, as promised last week. In connection with the accompanying report of Consulting Engineer FTELEY, which we have yet to publish, it constitutes probably the most valuable and carefully studied information extant in regard to the proper design of such dams.

To the Honorable Aqueduct Commissioners:

GENTLEMEN: I herewith respectfully submit the report called for by your resolutions of March 24, 1886, and June 22, 1887, on the subject of High Masonry Dams, both curved and straight in form

The plans presented for the straight Quaker Bridge structure were made after long study of the forces and strains to be sustained, allowing for large factors of safety against overturning, crushing and sliding. The



Figs. 1, 2, 3.—The Arch applied to the Quaker Bridge Dam.

best proportions and form consistent with safety and reasonable economy were designed, with great care to meet all requirements of strength and stability.

The world's experience in the designing and construction of great dams, together with the investigations and opinions of the highest authorities, in Europe and America, were collected and considered in the plans prepared and presented to the Commission.

The strength and cost of a straight dam, resisting hydraulic pressure, ice, wind and wave action by its weight only, was compared by mathematical results with the stability and cost of a dam in the form of a

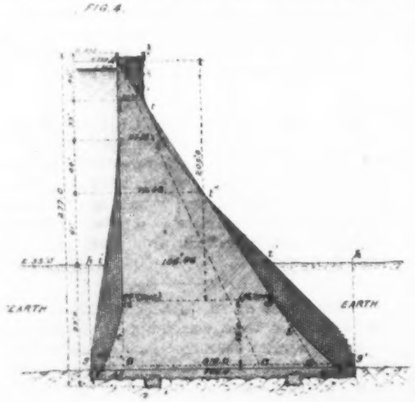


Fig. 4.—Theory of a Gravity Dam.

horizontal arch, transmitting thrusts to the hill-sides. For the Quaker Bridge structure, the strength, economy and safety of the straight dam, so far exceeded what was obtainable by the curved form that I can only account for the construction on a curve of so many large modern masonry dams, from the fact that only within a few years has the question begun to receive the attention it deserves from trained and experienced hydraulic engineers and authors.

The popular belief in masonry arches to bear great weight or pressure, is justified when confined within reasonable limits. But no masonry bridge arch of over 300 ft. span has been constructed.

Beyond that length of span, the crushing strain, sustained by voussoirs, exceeds safe limits on their mortar joints from the weight of the masonry alone, without the added load the bridge should carry.

It would, therefore, be out of the question to construct a masonry bridge of the length of Quaker Bridge Dam (1,350 ft. long) as it would be over four times the limit of safety in a possible span. The arch of a curved dam, however, does not carry any part of its own weight (as in the case of a bridge), therefore, its strength of arch will bear only the water pressure against it from a full reservoir.

I invite your attention to the following statements on the curved form.

1st. When the section of the Quaker Bridge Dam is of a required area of cross sections to resist reservoir pressure by its own weight, and is then built on a curve, the dam cannot act as an arch.

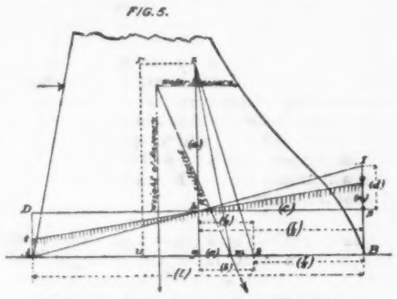


Fig. 5.—Bazilly's Trapezoid of Pressure.

Such a section (See *E F G H*, Plate *B*) will closely approach the shape of a right angle triangle, with its apex at the surface of the reservoir.

The water pressure against it, from a full reservoir, will be nothing at the surface, and as the pressure increases, at successive depths, a corresponding thickness of masonry in this section increases in due proportion down to its base to sustain such pressure.

In order that arch thrust may act to transmit pressure to the hill-sides, an elastic movement of the masonry, resulting from water pressure, must, of necessity, take place to produce such thrust.

This approximate triangular section of masonry is of a form that will best resist and practically stop such elastic movement, in the plane of the cross-section, that transmits arch-thrust. It must be remembered that the possible elastic movement of the vertical transverse cross-section is insignificant when compared with the longitudinal elastic yield through so long a dam.

In short, the stiffness of the triangular cross section prevents the far greater longitudinal elastic movement required to permit appreciable arch-thrust to reach the hill-side.

Therefore, a long, curved dam with a gravity section will resist hydraulic pressure against it by its own weight, and not by arch action.

2nd. Let us next consider the effect of reducing the cross-section for a curved dam at Quaker Bridge, by reducing its breadth of base and thickness of masonry, to a degree that permits bending, or elastic movement, that will allow the dam to act as an arch. Assume the thickness of the dam forming the arch ring to be from 80 to 100 ft., and that it will be sufficiently elastic. We then find that, with a radius of 900 ft., we will have a pressure on voussoir joints of from 42 tons to the square foot with 80 ft. breadth of section, to 39 tons with 100 ft. breadth of section, on the supposition that the line of strain bisects each joint. Such pressures are, however, beyond safe limit for hydraulic masonry. Again, the elastic movement will throw the weight resultant near the end, or outside of the base, causing a tensile strain in horizontal joints of the inside face, which should not occur, as it causes a tendency to rupture the masonry and create leakage.

It is evident, therefore, that we cannot reduce the section or thickness of so long and high a dam in order to force it to act as an arch, without causing dangerous and complicated strains.

3rd. We must next consider the effect of increasing the cross-section or thickness of the dam at Quaker Bridge, in view of broadening the voussoir joints for reducing the thrust pressure of a curved dam of 900 ft. radius, to 16 tons per sq. ft., the limit of pressure in the straight gravity plans, which have been submitted to you. We find that it produces a section (*A B C D* Plate *B*) that is nearly double that required for a straight gravity dam, (*E F G H*) having proportionately less tendency to act as an arch, than in the first mentioned case; while, at the same time, it adds 100 per cent. to the cost.

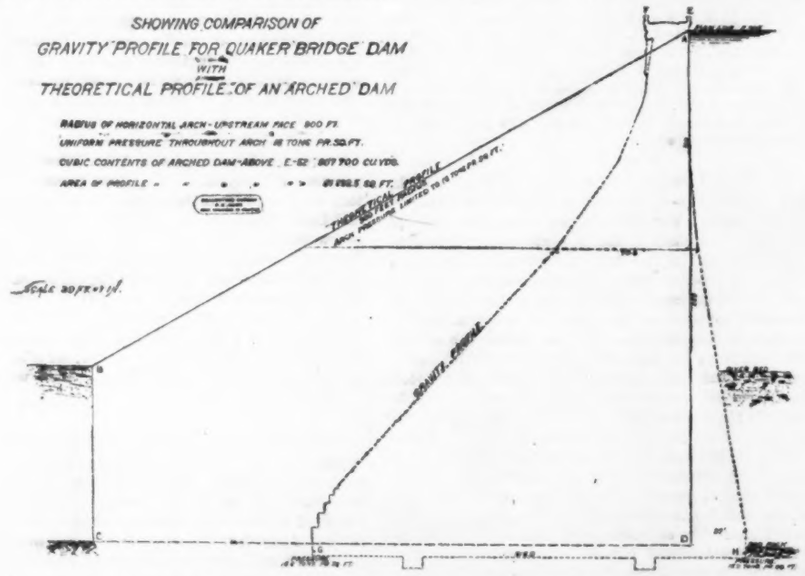
It therefore, becomes evident that it is impossible to construct a curved dam at Quaker Bridge which will act as an arch to any appreciable degree, and consequently there is no valid reason for risking the complicating and serious rupturing strains, which a curved dam will produce; or, for the increased expense it would entail.

In order to verify the above statements and figures, I have worked out a formula, and used it for the calculations on curved dams herein given, verifying them by the formula of moments, where that formula became applicable. (See Plate *A*, Fig. 1).

In a curved dam having a radius R sustaining a weight of water pressure W and total pressure p on a voussoir joint of any span or chord C, then we have the formula $p = \frac{R.\ W.}{C}$

The demonstration of the above formula is as follows: (Fig. 1).

Let *A E* and *B E* be drawn perpendicular to the radii *A D*, and *B D*, and tangent to the curve *A W B*. Take


SHOWING COMPARISON OF
GRAVITY PROFILE FOR QUAKER BRIDGE DAM
WITH
THEORETICAL PROFILE OF AN ARCHED DAM
RADIUS OF HORIZONTAL ARCH - UPSTREAM FACE 900 FT.
UNIFORM PRESSURE THROUGHOUT ARCH 16 TONS PER SQ. FT.
CUBIC CONTENTS OF ARCHED DAM ABOVE E-F 807,700 CU. YDS.
AREA OF PROFILE " " " " 69,695.50 SQ. FT.
THEORETICAL PROFILE
ARCH PRESSURE LIMITED TO 16 TONS PER SQ. FT.
GRANITE CONCRETE

Gravity and Theoretical Arch Profile for Quaker Bridge Dam, compared.

E g equal to the weight *W* of water pressure on a belt of the dam 1 ft. in breadth, and the length of the chord.

From *g* draw *g h* and *g i* parallel to *E B* and *E A*. Then will *E h g i* become a parallelogram of forces, and *E h* equals one component, normal to the voussoir joints at *A*, and equals the total pressure *p* on that joint.

The triangle *E h g* is similar to the triangle *A D B*, their sides being perpendicular to each other, therefore

$A\ B : E\ g :: A\ D : E\ h$, or $C : W :: R : p$, and $p = \frac{W\ R}{C}$

The radius, weight and chord, or span, being known, the pressure *p* is found by this formula, which being divided by the area of the joint in square feet gives the average pressure per square foot.

This formula proves the fact, that with a given radius, the total pressure on each of the voussoir joints is equal and remains the same to all lengths of span, from the lengths of a voussoir, to the total length of the dam, and that the pressure on voussoir joints increases as the length of radius increases. If we assume a value for *p* we can find the value of *R* by the above proportion, which becomes $R = \frac{C.p.}{W}$.

Now, if we assume a rectangular section, equal to the area of the section presented for the straight Quaker Bridge Dam, it will be 101 ft. in breadth, limiting the pressure to 16 tons per sq. ft. then p or the total pressure on a voussoir joint, 10 ft. long on the extrados chord, will be 1616 tons at a depth of 107 ft. below the surface and W will be 51 tons for the same span of 10 ft. on a belt 1 ft. broad.

Then, by the formula, $R = \frac{C.p.}{W}$ equals 316.8 ft. as the length of the radius required to maintain the conditions. This radius will not be long enough to span the Valley at the Quaker Bridge site, even with a half circle.

In other words, with the same area of section in the better shape to act as an arch (because it admits of greater elastic movement), and with the same limits of pressures that exists in the plans before you for the gravity Quaker Bridge Dam, the radius must be so short that the dam cannot span the valley. To further illustrate the above statements and call your attention to another important matter bearing on the subject of the Quaker Dam, I will suppose that the Quaker Bridge Dam be built on a curve having a radius of 900 ft.; that instead of being a dam, it is a wall 250 ft. high, making a complete circuit forming a well, resisting water pressure on its entire exterior circumference, 260 ft. in depth, as in Fig. 2.

The voussoirs all being of equal size it is evident that the hydraulic pressure W normal to the outer chord of each of the voussoirs, will be the same at any fixed depth below water surface, and the total pressure on all the voussoirs joints will be equal.

The thrusts of all the voussoirs will balance each other and produce an equilibrium of voussoir pressures in any horizontal plane, at any depth, all around the circle, because the elastic movements to produce these pressures is perfectly balanced. The pressure of a, (Fig. 2) towards b equals b towards a, and the pressure of e towards f equals the pressure of f towards e, etc. Now a hill-side abutment may be substituted for voussoirs a or e.

Therefore with the same radius and section of dam, increasing the span, does not increase the total pressure on voussoir joints as above stated.

In the complete circle, however, perfectly balanced elastic movement takes place to produce uniform pressure on the several voussoir joints.

But when the thrust of a curved dam is sustained by unyielding hill-sides, the hill-sides do not respond to the elastic movement (as in the case of voussoirs in the complete circle), consequently the line of transmitted resultant pressure through all the voussoirs cannot pass (as in the complete circle) uniformly through the same part of the voussoir joints, but will take a direction approaching to the line, d, d, d, in Fig. 3; because of the tendency of the arch to flatten, and take the form of the dotted lines in Fig. 3.; therefore, with a fixed radius, although the total pressure on the voussoir joints does not increase with the span, the resultant line of transmission of thrust does increase crushing strains.

It causes the line d, d, d, to fall near the ends of the joints tending to greatly increase the strains, so unevenly distributed on the different joints, and also tends to buckle and crack the arch, as well as to crush.

No experimental data or formulæ exist to enable us to measure these arched dam-thrust strains with any degree of accuracy.

It is probable that the line of strain near the center and ends of the dam will fall outside of the middle third of the joints, more than doubling the crushing strain of 42 tons, given in the second case mentioned above, or over 82 tons to the sq. ft.

Therefore, the building of any arched dam must be regarded as experimental in character; it is far safer and less expensive to avoid such complications and build straight dams to resist hydraulic pressure by their weight only.

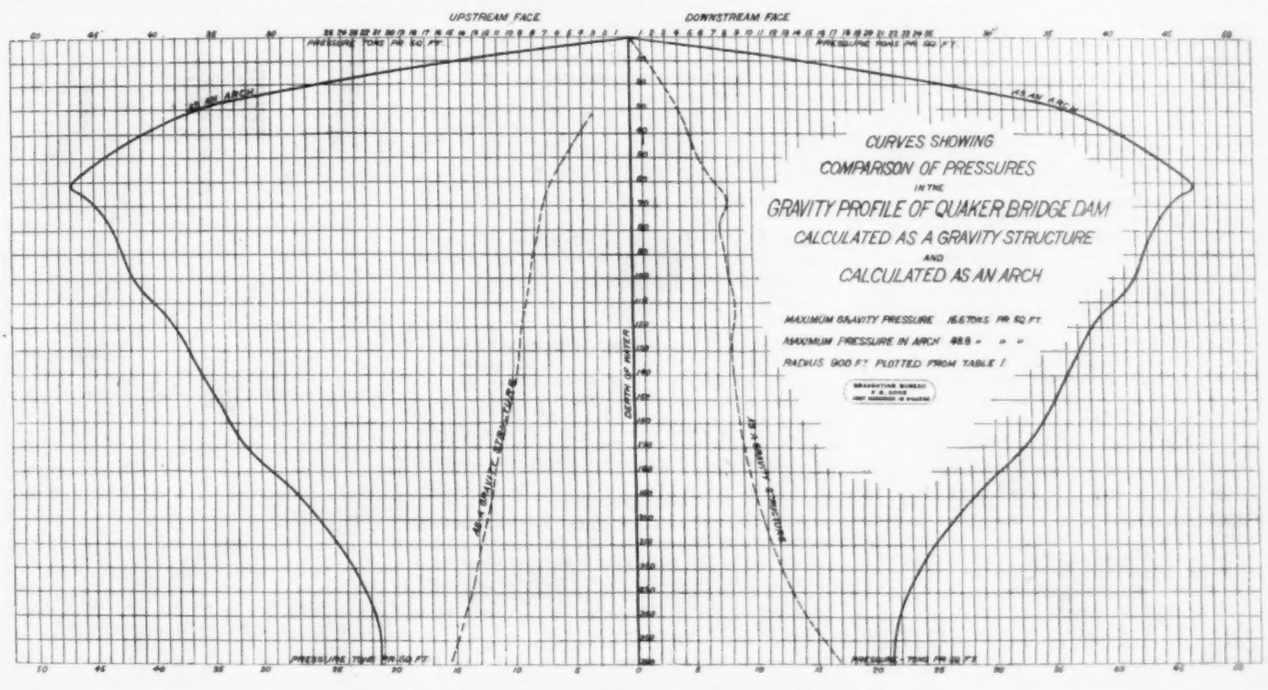
The most reliable formulæ for giving the maximum pressure on the outer and inner toes of a gravity dam are not perfect, because no adequate experimental data exist to give the elasticity of large masses of masonry upon the principal dams existing there. From his examinations and studies during his trip, he pronounced against the curved form; but his subsequent illness and death prevented the completion and presentation of his report. I can, however, testify to his stating that opinion to me while I was associated with him as Consulting Engineer in the Department of Public Works.

McMASTERS holds that, having established a profile that will resist the pressure of water by its own weight, there is no valid reason for constructing it in the form of an arch, and thereby increasing its length and the cost of its construction.

The standard authorities, both in Europe and in this country, agree that in long and high dams the sectional profile should be capable of resisting water pressures against it, by its own weight; and that the curve increases the cost without adding to its strength.

In fact, these general considerations militating against the arch have so satisfied them that they have not considered it necessary to go into more elaborate demonstrations.

Inasmuch, however, as the curved form has been pressed by several speakers during the public hearings before this Commission, it becomes desirable that a careful statement be given you of the inapplicability of a curved form for long and high dams.



Comparison of Pressures between a Gravity and Arch Dam.

The horizontal, or bed joints in the stone masonry constructions are always more perfectly filled and are stronger than the vertical joints. The weight of each stone maintains its bed and as the load of superincumbent masonry increases upon it, these joints become more firm and compact.

With the vertical joints this is not the case. In the straight dams, therefore, the most complete and strongest bed joints bear all the strain from the reservoir water pressure against the dam, and the vertical joints of lesser strength are relieved from strain, while the reverse is true of the curved form.

The plans for the Quaker Bridge Dam, submitted to this Commission, have received, as its magnitude and importance deserve, a longer and far more thorough consideration and study than has been given to any existing dam, and I, therefore, urge their acceptance with confidence.

Fig. 4. Plate A will illustrate some static principles relating to gravity dams, wherein $A\ B\ D$ is the form of a theoretical dam, calculated to exactly sustain the overturning pressure of water against it.

There being no factor of safety against overturning, the resistance of the dam and the pressure of the water are in exact equilibrium.

With these conditions, the resultant of pressure strikes at the end of a horizontal joint, and the dam takes the shape of a triangle, however high the dam may be. This, under the supposition that no arbitrary limit of pressure be fixed for the outer and inner toes, and that the tendency to crush is ignored.

Let us now introduce a factor of safety of (2), against overturning, by adding to the breadth of the dam to increase the length of the joints.

Many of the high dams we have obtained records of, are built on a curve, but all except one act as gravity dams, and their arched form must weaken their stability.

The only existing curved dam which can and does act as an arch, is the Zola Dam, 205 ft. long, 126 ft. high, 41 ft. broad at the base.

I believe that sooner or later it will fail, becoming ruptured and weakened by the action of changing pressures from the drawing out and refilling of its reservoir storage.

To sustain the above statements, I will refer to the following authors: PELLETREAU advises that the arch form should not be used when the dam is more than 131 ft. in height and length.

DELOCRE believes that the structure would cease to act as an arch when the thickness of this arch would reach one-third of the radius, and calculates the limit to be reached at a depth of 14.7 ft. below the flow line and confines it to very short spans.

KRANTZ gives the limit of the span at 131.2 ft. with a radius of not more than 65.6 ft.

RANKINE suggests that in very short spans, a slight curve be introduced to prevent the bending out of the top of the dam by water-pressure against it; but states that he has no confidence in calculations for stability for arch-thrust in long dams, and intimates that the arch form is of doubtful utility even in short dams. He insists that the section should be such as to resist overturning by its own weight alone.

Mr. E. S. CHESBROUGH was sent to Europe by the Department of Public Works to examine and report

This correspondingly increases the bulk and weight of the masonry to a degree that will require exactly twice the water pressure (to produce overturning) that a full reservoir can ever exert.

With these conditions, and ignoring excessive pressures, the dam again takes the form of a triangle, as shown on Fig. 4 by the lines *A B, A C, C B.*

But if (with masonry weighing 156.25 lbs. per cu. ft.) we limit the pressures at the toes of the dam to 16 tons per sq. ft., that pressure will obtain at the line *a a*, 205 ft. from the surface of high water.

Below that point, the limiting of pressure to 16 tons per sq. ft. will cause the straight lines of the triangular form to bend into the curves *a b E* and *a c F* maintaining uniform pressure below that point, lengthening the joints beyond the ratio of the triangle which produces curves.

We will next consider the reasons for departing from the last described theoretical section *A F E*, to that of the section under consideration, shown by the outer dark lines of Fig. 4.

In the theoretical section the resultant forces strike exactly at the end of the middle third. Any additional strain of ice, or wave and wind action would, therefore, produce tensile strains on the inner face as above stated.

To prevent such strains, the section must be broadened lengthwise with the joints, to distribute the increased weight.

Again, as the maximum pressure will be on the reservoir side, or inner toe, during construction, before sufficient age has given the mortar time to thoroughly harden, we must make a second increase of section to obtain smaller pressures than will exist at the outer toe with a full reservoir.

The maximum strain with a full reservoir will not come upon the outer toe for months after the structure is completed and the mortar is well hardened.

The weight of the gravel and water resting on both toes of the dam up to the river-bed at *g h i* and *g' h' i'* (not considered in the theoretical section) calls for a third increase.

To maintain the limitations of pressures fixed upon, the back pressure below the river-bed against the outside of the dam (not considered in the theoretical section) demands a fourth variation, which slightly diminishes the section.

The fifth variation, increasing the area of the section, is required to thicken and strengthen the outer toe.

We now come to the last cause of change from the theoretical section at the top of the dam. This sixth increase of section and weight on the diagram (shown at *A k t*) is required to resist ice, wind and wave action.

The addition of this weight enable us to encroach upon the theoretical section at *t, t', t''*, without reducing the several factors of safety below the limit fixed; while it adds to the required breadth of section throughout the lower portion of the dam.

The strain sheet, and its tables, exhibit how evenly all the factors of safety are maintained in the final section, under consideration, providing for all the above mentioned disturbing conditions.

As no demonstration could be found of SAZILLY'S trapezoid of pressure for great dams, I have developed one and obtained a formulated and graphic method of calculating the pressures on the outer and inner toes of joints of high masonry dams, and used them to recalculate the pressures on the strain sheet obtained by the formula of moments, as a check on those results.

By this method, as in all others, we must neglect the factor of elasticity in masonry, which affects the results but slightly, and introduces a factor of safety. The demonstration is as follows: (See Fig. 5).

When the resultant of horizontal and vertical pressures cuts the joint or base *A B* in the middle, all the vertical components must equal each other, and each will equal the total weight of masonry *W* divided by the length *l* measured by the lines *A D, g h* and *B S*. Then the trapezoid of pressures becomes a rectangle and the resultant will cut the base at the same point *g*, where a vertical line passing through the center of gravity of the rectangle meeting the base.

When the resultant cuts the base, *A B*, at the end of its middle third *k*, then the aggregation of all the vertical components will form a right-angle triangle *I A B*, measuring the total weight of masonry, and consequently equal in area to the rectangle *A B S D*. The resultant will also cut its base at the same point *k*, at which a vertical line passing through its center of gravity will cut the base. This triangle must have a height *B I*, equal to twice *g h*, and equal to $\frac{2\ W}{l}$ and will equal the pressure *p* at *B*, the outer toe of the dam, while the pressure on the inner toe *A*, becomes zero.

If the resultant should cut the base outside of the middle third, the pressure at *A* would become a minus quantity producing undesirable tensile strains. This illustrates the reason for confining the intersection of the resultant within the middle third of the base. When the resultant cuts the base within and at any point other than at the middle, or at the end of the middle third, a trapezoid will be formed which must be equal in area to the rectangle or the triangle. A vertical line dropped through the center of gravity of this trapezoid and also the resultant must cut the base at the same point.

In the rectangle of pressures when the resultant cuts the center of the base both *p* and $p' = \frac{W}{l}$.

In the triangle, when the resultant cuts the end of the middle third $p = \frac{2\ W}{l}$ and $p' = o$.

To find the pressures *p* and *p'* when the resultant cuts the base at some other point *m*, produce *g h* the vertical component of the rectangle at the middle of the base, upward through *Z* and perpendicular to *D S*. At the point *k*, where the resultant of the triangular area of pressures cuts the end of the middle third of the base, project a line perpendicular to *A I* until it meets *g h* produced at *Z*. From *m* draw the straight line *m Z* and through the intersecting point *h* (common to the upper sides of all possible trapezoids of pressure) draw the line *o t*, perpendicular to *m Z*. Then will *o B* = *p*, and *t A* = *p'*, the pressures sought.

The sides of the triangle *k Z g*, are perpendicular to the sides of *I S h*. These triangles are therefore similar. For the same reason, the triangles *m Z g* and *o h, S*, are similar.

Representing the lines *Z g* by *a*, *k g* by *b*, *S h* by *c*, *I S* by *d*, *m g* by *e*, and *o S* by *n*.

Then $a : b :: c : d$ and $a : e :: c : n$

Therefore by alternation $b : d :: e : n$

$$\text{and } n = \frac{de}{b}$$

The triangles *o S h*, and *t D h* being similar and equal; and the line *B, S* being equal to *S I* or *d*; when the dam resists water-pressure against it,

$$(1)\ p = d + \frac{de}{b} \text{ and } (2)\ p' = d - \frac{de}{b}$$

With no water pressure against the dam

$$(3)\ p = d - \frac{de}{b} \text{ and } (4)\ p' = d + \frac{de}{b}$$

In the above formulæ $b = \frac{l}{6}$, $d = \frac{W}{l}$ e = the distance of the center of *l* from the point where the resultant cuts it.

GRAPHIC METHOD.

Having fixed the point *Z*, by the method above described at the intersection of *g Z* and *k S*, from the point *m* where the resultant cuts any part of the base *l* connect the points *m* and *Z* by a straight line. Through the point *h* draw a straight line perpendicular to *m Z*, cutting *B S* and *A D* (or these lines produced) at *o* and *t*, then will $p = B\ o$ and $p' = A\ t$.

By making one-sixth of the base measure $\frac{W}{l}$ in tons to the square foot (*u* being the end of the middle third) then the triangles *Z g K* and *h S I*, also *Z g m* and *h S o*, are not only similar but equal, and $p = u\ m$ and $p' = K\ m$ measured directly from the strain sheet, when a scale one-sixth of the base measures and equals in tons $\frac{W}{l}$.

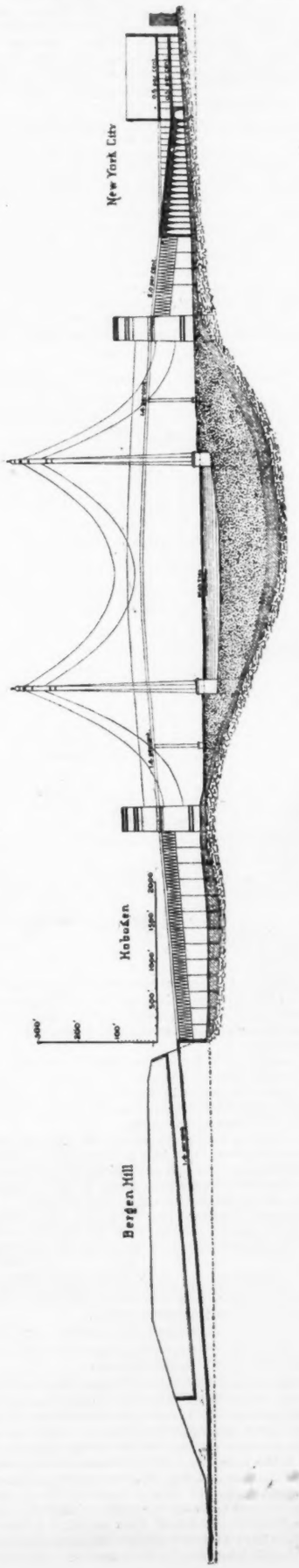
The same data being required for both the formula and graphic method, makes it convenient to check one by the other.

As Consulting Engineer, A. FTELEY could best give time to arrange, collate, and present to you the information we have obtained respecting existing dams, called for in your resolution I have requested him to embody those matters in his report, together with any further detailed technical presentations that might suggest themselves to him.

The details for the tightest mode of bonding, by breaking joints vertically as well as horizontally, the systems of masonry in construction, and a method of securing tightness on the interior face, I have prepared for contract and working drawings to be made, when the Commision has settled on the main features of the plans now under consideration.

[A table is then given of a section of Quaker Bridge dam acting as an arch of 900 ft. radius, calculated by formula $p = \frac{W\ R}{C}$, which we omit.—ED.]

THE engineering and mechanic arts department of Swarthmore College, near Philadelphia, has been presented by the sons of the late Mr. EDWARD STABLER, of Sandy Spring, Md., with the entire outfit of the foundry of their father. This includes all the appliances of a foundry and the patterns of the many presses and seals made for the national and state and city governments.



Profile of the Proposed North River Bridge, G. LINDENTHAL, Engineer.

The Proposed North River Bridge,

We begin this week the publication of a series of drawings showing the details of this great engineering project, which we are informed has a very fair chance of going through, and which has certainly been so carefully worked out that it will be studied with great interest by engineers whether it goes through or not. Next week we shall begin the publication of an abstract of Mr. LINDENTHAL'S paper. This week we give only two drawings which explain themselves. The first is the large inset sheet on which are shown to the same scale a number of the greatest bridges of the world in comparison with what will be by far, if constructed, the greatest of them all in every sense. The second is a condensed profile showing the general nature of the complete project, including the approaches. The grandeur of the project is almost appalling, creating at first sight a natural feeling that the chance for its construction must be small, but this is an age of great enterprises and of super-abundant capital for anything which it can be shown will "pay", directly or indirectly. We think there is abundant reason to believe that such a bridge as that proposed would pay even now, while the engineering difficulties are certainly less formidable for the resources of to-day than were those which confronted the St. Louis, East River, and many other bridges, when their construction was begun.

The Theory of Shot-Firing in Mines, Etc.

M. P. F. CHALON, Engineer of Arts and Manufactures, comments in *Le Genie Civil* upon our several articles on tamping, air-space, etc., by giving a general theory of shot firing in mines, with common powder or high explosives; a theory susceptible of application to tamped holes, or holes simply closed by a plug of some nature. We translate the article as follows:—

It is important to first well establish the difference which characterizes the high explosives of the nitro-glycerine type and mining powder of the nature of ordinary black powder.

When we detonate a morsel of fulminate of mercury in a charge of nitro-glycerine, the total reaction is, so to speak, instantaneous, because each morsel of nitro-glycerine constitutes within itself an explosive properly so called.

There is not this same condition with powder. For, no matter how intimately we mix the different

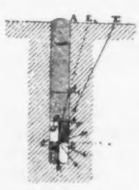


Fig. 1.

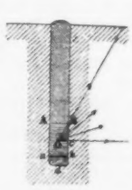


Fig. 2.

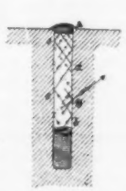


Fig. 3.

elements which enter into its composition, it is absolutely necessary that there be a juxtaposition of several kinds of grains (sulphur, saltpetre and charcoal, for example) before a combination can be formed susceptible of bringing about an explosion. Consequently the reaction which acts step by step, demands for its complete effect an appreciable lapse of time.

We will now examine what takes place in a charged drill-hole, which for present purposes we will suppose to be vertical, and the charge fired with or without tamping. We will consider the two cases, when the charge is tamped or not, and with a high explosive (95 per cent. nitro-glycerine) or a slow powder.

1. *Hole Charged with Tamping.*—Case *a*, with a very high explosive. The charge is capped with 1 or 2 grammes of fulminate of mercury which, in detonating, acts up and down and at once disassociates every particle of the explosive; and at the same time tends to give to the gas resulting from the decomposition an impulse directed towards the bottom of the hole.

There is thus a crushing effect at the bottom of the drill-hole. This would be crushing pure and simple if the explosion was rigorously instantaneous; but in reality, it is not exactly so, because the explosive is not perfect. The reaction extends over a certain length of time, or is in fact a succession of partial reactions. So we can admit the formation of a gas chamber, and in consequence a development of lateral pressure.

The result of the general explosion is a crushing at the bottom and a dislocation of the sides. This action is the more active as the space occupied by the explosive, and the gas-chamber which replaces it, is longer.

Fig. 1 shows these effects. The center of the charge being at the point *O* there is then, after the transformation of the explosive into gas, the forces of dislocation; these are comprised in the two sectors *a o c* and *a o c'*, and the pressures on the bottom are included in the other two sectors *b o c* and *b o c'*.

The first of the above forces acts with more efficiency as the resistance opposed by the rock is less, and in consequence the line of fracture *o d* will be more elevated, as in *o' d'*, for example. We can conclude then that, when using a very violent explosive, there is an advantage in a hard, resisting tamping in a deep narrow hole.

(*b.*) *The Case of a Slow Powder.*—The decomposition of a slow powder, directly fired by a match or fulminate, is produced by stages. We can assume, for demonstration, that the charge is divided into a

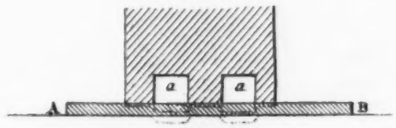


Fig. 4.

number of thin super-imposed layers, and that each of these layers constitutes a complete explosive by the conjunction of essential elements.

To commence with, the downward action of the cap upon the upper plane *A B* of the charge (Fig. 2), produces a decomposition of the first layer. The result is the formation of a small gas-chamber with action in every direction. The downward pressures put the second layer into action and decompose it in turn, producing a new quantity of gas, increasing the size of the gas-chamber and, as a result, adding to the lateral effect. The reaction is thus obtained by steps; then if the lateral effort is sufficient to produce dislocation, this breakage generally comes before the powder has been completely decomposed and the gas escapes by the cracks made, and tends to project the fragments.

If *a b d* (Fig. 2) represents the unburned powder remaining after the breaking of the sides takes place, there would then be a gas chamber *A B b a*. The pressures acting directly against the sides of the hole and tending to produce dislocation are comprised in the sector *B o c*. The points of application are here too far away from the face of the hole and consequently the work left in this powder is badly utilized.

If the tamping is not sufficiently resisting and yields too quickly, the duration of the reaction is reduced and the quantity of powder not utilized is still greater. Further, the lateral thrust is more or less decreased and tends, by the increase in the size of the gas-chamber as the tamping gives way, towards a transformation into a projecting force which acts upon the rock fragments. All the rest of the work, that the powder should properly do, is completely lost.

Finally, if the tamping is too loose and gives way at the start, a very great part of the explosive effect is exerted from the bottom towards the top of the hole, the tamping is thrown out like a ball from a cannon, and a "gun" is the result. The lateral pressures have no time to act at all and the whole action of the powder is lost. We may admit, for an instant that the powder is completely burned before any is thrown out; the reaction may have taken place, step by step, even to the last layer, but the general effect is vertical and from lack of resistance above the bottom breaking is much reduced. If the combustion is incomplete, which is generally the case, this breaking effect is still less. This is why slow-burning powder acts relatively with little effect upon the bottom of the hole, as compared with quick explosives.

From the preceding we can draw the following conclusions relating to the tamping:

(1). It is necessary to tamp as solidly as possible.

(2.) The shorter the tamping the greater is the breaking effect. This would be a maximum if the pressures could act upon the whole inner surface of the hole from bottom to top.

We are thus led logically to the reduction of the tamping to the minimum of length; or, *its replacement by a simple plug, hermetically sealing the opening and presenting a sufficient resistance at the same time.* And we will now proceed to the study of this latter case.

(2.) *The Drill-Hole Closed by a Simple Plug.* (*a*)—With violent explosives. By reason of the almost instantaneous decomposition produced by the firing of a fulminate cap, the effect is practically the same as in the preceding case, whether nitro-glycerine, explosive gelatine or gun-cotton is used.

With dynamite and other like explosives, the duration of the reaction is greater and the action is comparable to that of powder, excepting in that which concerns the breaking, which as a general rule is as much greater as the time consumed in the decomposition is less.

(*b.*) *Slow Powders.*—The charge is supposed to be in the form of thin layers. When the initial shock has been given by the match or fulminate, the first layer is decomposed into gas and acts in every direction. The pressure downward acts upon and decomposes the second layer. The other pressures give oblique components which drive the air with violence against the sides of the hole and are then reflected by consequence of the resistance of the rock. We obtain in this way the pressures *ab*, *bc*, *cd*, etc., (Fig. 3), which grow less as they pass on toward the top of the hole, and when they reach the plug have little force left to expend. Beyond the decomposition of the second layer a new series of forces is loosened, and so on to the bottom.

The general result is a series of undulations arriving *successively* at the plug *A* (Fig. 3) where they are reflected in an inverse sense to the length of the sides, and where the later forces arriving meet those of earlier origin. At some one point, *O* for example, two series meet coming from different directions and act as a wedge in the dislocation of the sides. As each layer of powder is decomposed the lateral forces increase step by step in intensity until they end in rupture at the points of least resistance in the sides. The attack is made over the whole inner surface of the hole from the bottom to the top, and as a consequence the explosive force is exerted under extremely favorable circumstances. On the other hand, as the effect is spread over a greater number of points at one time, it is necessary for the proper breaking to develop a more considerable sum of pressures and, in consequence, to decompose a greater quantity of powder.

This is the first result, of the mechanical order, produced by an air-chamber superimposed on the charge. But an essential factor is the best combustion of the powder and the retention of the gas. We have assumed that the series of undulations arrive at the mouth of the hole so reduced in power that they will not lift the plug; and to accomplish this properly the air-chamber must present a determined minimum length.

Experience confirms this fact. In mine holes of little depth, where the distance between the charge and the plug is less than 1.3 ft. to 1.6 ft., the plug is simply driven out. In this case it has been observed that the escape of gas is relatively slow and is accompanied by the characteristic whistling sound, which confirms our theory that the consecutive undulations strike the sides of the hole before reaching the opening.

We can now study the effect of an excess of powder used. At a given moment the two forces which make the angle at the point *O* (Fig. 3) crack the rock; since the disengagement of the gas continues, this gas penetrates into the crack formed and pushes out the disengaged block; it then projects this fragment and as a result work is wasted. It is then a great error to believe that the heavier the charge the greater will be the effect. The crushing at the bottom of the hole only takes place as the powder is completely burned; it is an effect produced by the vertical action transmitted from the last powder layer; this latter cause being comparatively feeble, the crushing in itself is of little importance.

All that precedes applies to dynamite and relatively slow explosives as compared with pure nitroglycerine. To sum up, to obtain the maximum utilization possible in powder or an explosive of the dynamite type it is necessary:

(1). To hermetically seal the mouth of the drill-hole with a simple but sufficiently resisting plug.

(2). To make the hole deep.

(3). To regulate the distance between the charge and the plug in such manner that it will never be below a certain minimum, to be determined.

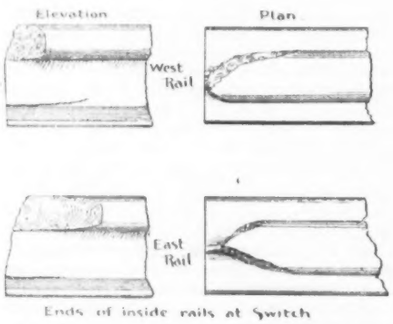
(4). To augment the initial effect and diminish the duration of the reaction in the firing, even in the case of more common powders, by using fulminate of mercury instead of a simple fuze.

The theory given enables us to explain certain other results like that of the impression of characters resulting from the explosion of gun-cotton on plates, as described by Prof. MONROE. In this case the fulmi-cotton may be considered as an explosive of a very violent nature, and the duration of the reaction as extremely short. When the fulminate cap is fired an almost instantaneous series of pressures is produced, and, as a consequence, they obey or follow chiefly the first impulse.

The air shut up in the depression *a. a* (Fig. 4) forms at once little atoms which are violently driven against the corresponding parts of the iron plate *B*- and there leave impressions exactly reproducing the contour of the original characters.

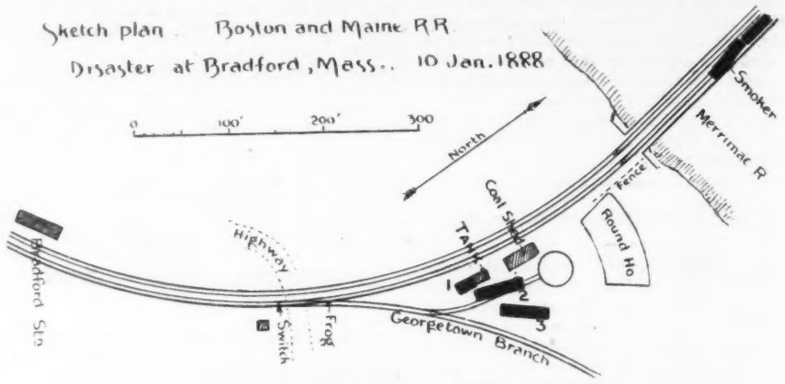
The Haverhill Accident on the Boston and Maine Railroad.

Probably most of our readers have already been made familiar by the daily press with the main facts and details of public interest regarding this unhappy disaster, and we shall therefore not refer to the sad and harrowing features of the accident, painfully apparent though they were to one on the spot, except to state that the total of casualties (10 killed and about 30 seriously injured) places this on record as probably one of the most fatal disasters of the year. We sincerely hope, and wish we might be able to prophesy, that it is the worst which 1888 will bring us.



The Haverhill Accident—The Switch Rails.

Briefly stated, the circumstances of the disaster were as follows: The train was a fast express on the Western division of the Boston & Maine Railroad, and left Boston at 1 P. M. on Jan. 10. The seven cars on the train were arranged as follows from the engine back: Milk car, baggage and express car, Pullman, smoker, and three passenger cars. But two stops are made between Boston and Haverhill, and the scene of the accident near Bradford station, across the Merrimac river from the city of Haverhill, was reached at 2 P. M. The train rounded the curve past the Bradford station shown in the accompanying sketch, at a probable speed of 30 to 35 miles per hour. The locomotive and the first three cars passed the switch all right. The front truck of the smoking car was derailed, but was kept in line as it remained attached to the car in front. As each following truck reached the switch it left the track and went wherever its momentum and the resistances it encountered determined. The smoker broke loose from the car behind it and followed the locomotive and head cars along into the bridge. Its wheels bumped over the ties and the car body careened far toward the outer side of the curve and brushed against a high board fence which helped to keep it from going entirely over, and at the bridge portal (where the fence was braced) brought it far enough into line so that it struck the Phœnix column, which joined the bridge end post, only a glancing blow. The trucks had been jerked to the left when they struck the guard rails and some of the wheels went towards the center of the bridge where they bunched and split the ties until the train came to a stop and the car turned over on its side near the end of the first span. Badly shaken up as were the passengers in this car, there were no serious injuries among them. Returning to the three cars which were detached at the switch, however, we find a far more serious record. As the car marked (1) on the sketch left the switch, it ran in a straight line over the frozen ground toward the water station. This consisted of two iron tanks set on a timber frame-work. The car struck these posts like a battering ram and ran half its length beneath the heavy tanks, which, deprived of their support fell down, crushing the roof and the sides of the car in an instant and causing the principal fatalities of the accident. The other two cars, numbered (2) and (3) were each deflected farther to the right, and the passengers in them suffered no fatal injuries.



The Haverhill Accident—Plan of the Tracks.

For the purpose of making a careful examination to ascertain if possible the actual cause or causes which led to the disaster, a representative of ENGINEERING NEWS was sent at once to the scene of the disaster, and without regard to the various popular and quasi-scientific theories which were floating from mouth to mouth, an attempt was made to discover the actual facts in the case. The salient features of the testimony are, first, a broken flange on the right forward wheel of the smoker. For a distance of 16 ins. the flange of this wheel is entirely gone, and at the point where the break was deepest it extends 1¾ ins. into the tread. This wheel was marked "M. C. B. Std., 1886, 15. J. S. Heartt & Co., Boston, Mass., Jan. 23, 1879." The iron appeared of good quality as far as could be ascertained, but the dirt and rust which covered the fracture prevented any positive decision upon this point. The next point of interest was the two inner rails at the switch, the ends of which are shown in plan and elevation in the annexed sketch. Evidently they experienced a severe battering, sufficient not only to cut the head diagonally across in the manner shown, but to crack the web away from the base for a distance of several inches. Add to this the facts that the end of the guard rail 6 ft. in front of the frog point was broken short off and that the planks of the road crossing were considerably broken, and it is plain that the derailment took place *at the switch* and not at the frog, as was originally stated. Whether the broken wheel was broken at the switch or a long distance back, it is certain that *every following wheel was derailed at this point.* Now it will certainly not be denied by anyone familiar with railway accidents, that on ordinary track the breakage of a wheel, provided the truck to which it belongs keeps in line, will very seldom derail following trucks. In this case the truck to which the broken wheel belonged kept in line remarkably well, and it must have been the action of the broken wheel upon the rail ends of the switch which turned every following wheel on such a fatal course.

The important point to be considered then is whether if a better form of switch had been in use at this point the derailment would have occurred. If the wheel was broken by the heavy blow which the stub switch gives to every wheel over it, then the switch and not the wheel was the primary cause of the accident. But even if the wheel was broken a long way back, it seems extremely probable that a good point switch, for instance, wouldn ot have been so cut up by this wheel as to derail every following truck.

It is not only our own opinion but that of the men in charge of the departments of maintenance of way on the best managed railroads of the country that (1) a facing switch is never as safe as a trailing switch, (2) that nothing but a reliable and well tested form of safety switch should ever be used on the main line, (3) that the old fashioned stub switch is *not* one that corresponds to the above description. We are obliged to say that we could neither find or hear of anything but stub switches in use by the Boston & Maine. Of the various turnouts between Haverhill and Boston, not a small number face the main line; though by the arrangement of the cross-overs between the double tracks, we conclude that instinct or something else, had taught the engineers that it was at least a little better to trail a turnout than to face it. Now the stub switch has some merits. Cheapness is one for instance. And facing switches are occasionally necessities. If the Boston & Maine or any other corporation chooses to use this old-fashioned but cheap device in their yards, that is their affair not ours. But when they keep a main line over which a large number of fast passenger trains run, equipped with a device which the best opinion pronounces unsafe, we respectfully submit that they are deserving of a censure which we sincerely trust will cause them to "mend their ways" till they are reasonably safe for the traveling public.

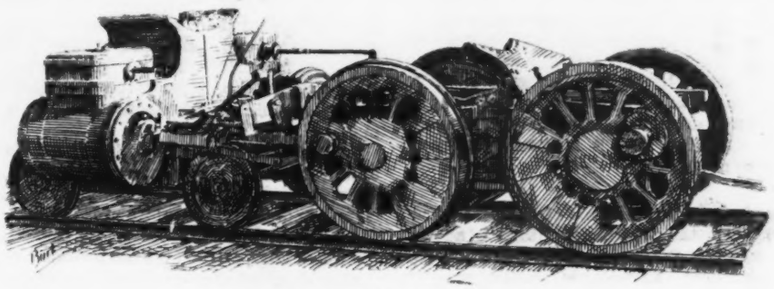
THE Westinghouse Air-Brake Co. has voted to increase its capital stock from $3,000,000 to $5,000,000. It is stated that $1,000,000 of this increase will go to stockholders in the shape of a dividend, and the other $1,000,000 will be available for subscription at par by railroad companies which adopt the improved Westinghouse freight brake.

THE Leslie rotary snow-plow—although "plow" is a very inappropriate name for this powerful machine, which cuts out and throws away the snow in a steady stream by direct mechanical power—is reported to be giving great satisfaction on several roads in the Northwest, notably on the Northern Pacific, where two are in use. It is a far more rational system than a plow proper.

LOSS OF POWER ON CABLE ROADS.—According to a recent test made on the Chicago City Railway, it was ascertained that about 36 per cent. of the gross power used in running that road was required to move the empty cable. Figures were made on a day of heavy traffic, and were as follows: 1,022 horse power were used to move 300 cars, only 360 of which was required to draw the empty cable. The cars were heavily loaded, perhaps 20 per cent. more than usual, and Secretary Windsor, who notes these facts, says that the amount of power required to haul the cable will not exceed 40 per cent. on the average. The *Street Railroad Journal* says the amount of power required per car for additional cars is about as the above figures show —viz., 2 horse-power each.

A Remarkable Boiler Explosion.

If not the most remarkable on record, the boiler explosion which we illustrate this week is certainly one of the most curious and complete, and is especially notable from the ease with which the weak spot in the boiler can be approximately located, merely by the position of the remote "fragments which remain," nothing being left connected with the running gear by which anything could be judged. We are indebted to Mr. CHAS. E. WEBSTER of the Atantic & Pacific R.R. for the photograph and blue-print from which our engravings have been prepared. Explosion occurred on that road Nov. 1 last, near Ash Fork station, at mile post 402.



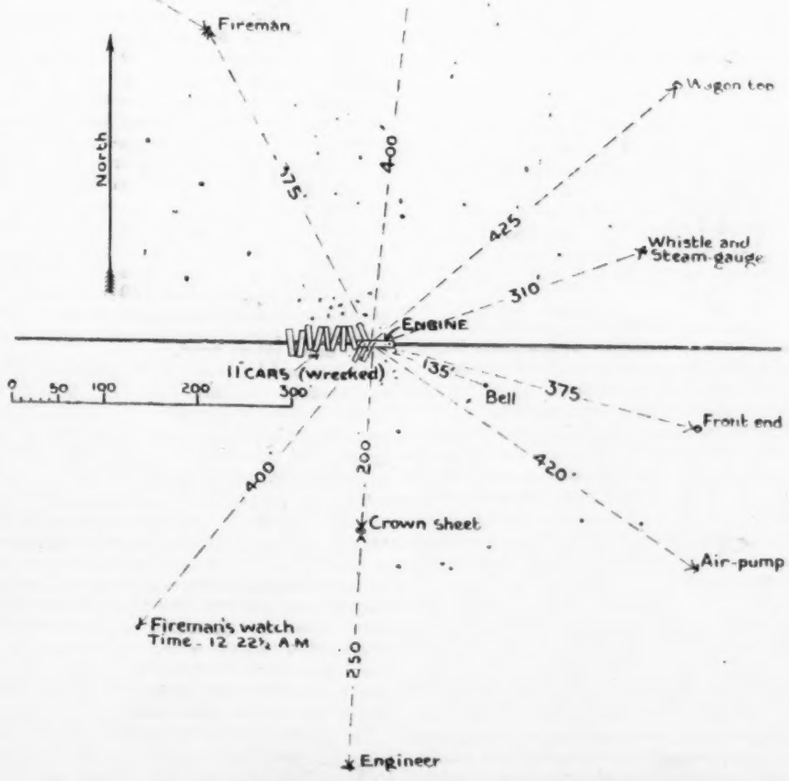
Remains of the Engine after Explosion.

The locomotive was originally an eight-wheel consolidation. All that remained of it in recognizable condition after the explosion is shown in our first view. The rest of it was distributed with impartial generosity to all parts of the surrounding country, as shown in our second view except the two rear pair of wheels, and some few smaller fragments, which were tangled up in the resulting wreck of cars; 11 cars in all being badly wrecked, and some of the others more or less injured. The train was a heavy one, and running at the time at ordinary working speed. The precise cause of the explosion is sealed in mystery.

The general nature of the explosion, however, is clear enough. The front end of the engine and boiler was torn completely free from the cylinder castings (as shown in the first view) and thrown almost directly forward, a little to the right. The engineer's body was thrown far to the right, and the fireman's and brakeman's (who was riding on the engine) still farther to the left; but the fireman's watch, by some mysterious chance, was snatched from his pocket (or was perhaps in his hands) and was caught by some opposing force which threw it in the opposite direction from himself. The hands had stopped almost to a second at the moment noted on the telegraph line as the time when the wire was cut by the explosion.

The crown-sheet was thrown almost vertically upward (as is apparent from the small distance it was thrown) but a little to the right. The wagon top of the boiler, and the air-pump, were thrown well forward, although placed toward the rear of the boiler. These facts all point to a rupture in the crown-sheet of an unusually serious character, a little to the left of the center, which was instantly followed by complete collapse. It would seem as if any ordinary breakage of stays or stay-bolts was insufficient to explain the great and *radial* violence, so to speak, of the explosion. In other words, the first impulse must have been down, or such impartiality in the lateral distribution of the fragments could not have resulted; for there can be no reasonable doubt that had not various rear parts of the locomotive been caught by the cars behind, and piled up in their wreck, they would have gone as far backward as other parts did forward and sidewise.

As a whole, it is about as curious a record of a boiler explosion as it has ever been our privilege to examine.



A Remarkable Boiler Explosion, Atlantic & Pacific Railroad.

PUBLICATIONS RECEIVED.

The Vosburg Tunnel.—A Description of its Construction, written and published by Leo Von Rosenberg, 35 Broadway, New York. Large Pamphlet; 56 quarto pages; 73 maps and plates; $1.00.

We should be glad to see every modern engineering work as well described as in this very valuable and complete account of the construction of one of the newest modern tunnels. The tunnel itself had many interesting features and this book gives extremely well just those details which every engineer wishes to know. The tunnel is double track, 3,902 ft. long and the headings met in one year and five months from the starting of work, which a few years ago would have been wonderful speed for a tunnel without shafts. In view of this fact the statement, which is well put in italics, *"No accidents were caused by the use of explosives during the construction of the tunnel,"* is in rather striking contrast with the records of most such works, as notably the new Croton aqueduct, and one of the most admirable features of this work is the full way in which it describes and illustrates just how the explosives were used. The contract prices and all similiar details of that nature are also given very fully, and as a whole the work is undoubtedly one which should be in the library of every engineer. We cannot now give as full details from the volume as we should be glad to, but it is in every way creditable to the author, from whom it can be obtained direct or through this journal. A feature which many will find interesting is the large map of the anthracite coal regions which closes the volume. The mechanical execution of the work is good throughout.

Map of the Alluvial Valley of the Mississippi River from the head of the St. Francis basin to the Gulf of Mexico. Showing lands subject to overflow; location of levees and trans-alluvial profiles. Published by the Mississippi River Commission, 1887. Scale—One Inch = 5 miles. In 8 unmounted sheets; colored.

This map, for which we are indebted to Mr. JOHN A. OCKERSON, U. S. Asst. Eng., St. Louis, Mo., is reduced from detail maps of actual surveys made originally by the Mississippi River Commission, the U. S. Coast and Geodetic Survey, U. S. Corps of Engineers, U. S. Land Surveys, and railroad, State and other reliable sources. It was compiled and engraved under the direction of 1st. Lieut. S. S. LEACH and Capt. THOMAS TURTLE, U. S. Engineers, by EDWARD MOLITOR, Principal Draughtsman. It is very handsomely published and must be invaluable to all interested in the progress and well being of the Mississippi Valley.

Locomotive Brakes. American Brake Co., St. Louis, Mo.

This new catalogue is exclusively devoted to locomotive steam brakes, in which the company has done for some years a large business. It shows for the first time one new feature, a device for operating steam and air brakes together by a link connection of the engineer's brake-valves, so that air may be used on the train and steam on the engine. The American Brake Co. also announce that they "are about placing on the market a simple and effective automatic air brake, which shall be interchangeable with the air brakes that are now in use," which, we believe, is the first official announcement of a purpose which has been unofficially understood for some time.

Memoirs of Col. James Worrall, Civil Engineer; with an Obituary Postscript by a friend. For sale by S. W. Fleming, Bookseller, Harrisburg, Pa. Price $1.00 post paid.

This is a volume of somewhat over 100 pages recording a simply told but most pleasing story of the early life and professional engagements of one of the older American engineers. It is interspersed with quaint observations upon men and events of the time, and reads rather as the jotted down thoughts of a type of engineer now almost extinct, than as a studied production for publication.

ENGINEERING NEWS

TRIBUNE BUILDING, NEW YORK.

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D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $6.56 *per Year*, or 3 *cents per number additional*.

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Coming Technical Meetings.

American Society of Civil Engineers, New York.—Annual meeting, Jan. 18, 19. Various constitutional amendments, elsewhere given, to be acted on. Reception, Jan. 19.

Boston Society of Civil Engineers, Boston, Mass.—Regular monthly meeting, Jan. 18; "An investigation as to how to test the strength of cements," by J. Sondericker.

American Institute of Mining Engineers.—Annual meeting at the Institute of Technology, Boston, Mass., Feb. 21 to 25.

Master Car-Builders Association.—Next convention at Alexandria Bay, New York, commencing June 12.

SEVERAL important amendments which will be brought up at the coming Annual Meeting of the American Society of Civil Engineers are given in another column, and members expecting to attend the meeting will do well to examine them in advance, in order to be better prepared to vote upon them. The first and second sets of amendments are commented on elsewhere. The third is not in regard to a constitutional matter, but in regard to one closely resembling it in importance, viz., present form of blank for proposing candidates. As it now reads, the candidate first commits himself to an application for admission to some particular grade, instead of for admission merely, to such grade as he may be found qualified for. He then applies to five personal acquaintances for their endorsement, and they are compelled either to endorse him as qualified for *some one particular grade*, or wound and offend their personal friend. Is it to be wondered at that, in view of the fact that the Board of Direction is the only final judge, and that it judges by a standard which the individual member does not create, and may not even approve of, proposers who may be anything but eager to do so will often weakly sign, on the ground that it is only fair to give the candidate a chance at least before the only final arbiters? The change proposed is that the application and endorsement shall state merely that the candidate desires and is fit for a connection with the Society in some grade, leaving the particular grade to be determined by the Board of Direction after separate inquiry, of the proposers and others, by a proper blank. If the candidate is unwilling to accept any other than some specified grade he can so state in his application, but many will be rather glad than otherwise to be relieved of the responsibility of classifying themselves.

A preposterous effort to have a "speeding driveway" laid out in Central Park is now being made in New York, and a public meeting has even been held in Chickering Hall, in response to a call from a long list of very rich men who wish to be thus provided with a trotting course at public expense. A more utterly improper and indefensible proposition could hardly be imagined, the only redeeming feature of it being that it has little chance of going through. The park is preeminently a place for quiet recreation and rest, especially for women and children, and the yelling, rowdyish crowds who would be quite sure to be attracted in large numbers by such a feature would go far to completely destroy its value to everyone else, without considering how it would deface the park to lay out in it a new trotting course, or any other new road whatever. It is difficult to speak with patience of such an improper proposition, but fortunately, it is so unlikely to succeed that it is not necessary to say much about it.

OUR contemporary, *Le Genie Civil*, while agreeing with us in the general advantages of an air-space over the charge in a drill-hole, sharply confines these advantages to the use of "slow powder, or dynamite," and to the exclusion of violent explosives of the nitro-glycerine or gun-cotton type. For our benefit, our contemporary gives in fuller detail the general theory of shot firing in mines, as elsewhere translated in this issue and does so on the assumption that we would favor the use under like conditions of what it calls violent explosives, or pure (95 per cent.) nitro-glycerine and gun-cotton.

Le Genie Civil misunderstands us in supposing that we advocate the use of pure nitro-glycerine or gun-cotton under the conditions described in its article. By the term "high explosive" Americans usually mean dynamite, as compared with the old black powder, and hence our original positions are practically the same.

WE have received several inquires concerning the method of "baling" sawdust for transportation, as mentioned in our issue of Nov. 19. The account there given was taken from an exchange, and we have no further information. If any of our readers have any knowledge of the process itself, and can describe it or say if it is patented, we will be happy to publish the same.

THE Minnesota Railroad Commission failed to make one very desirable addition to its recent order that all sleeping car upper berths not sold should be kept shut, so as to give the lower berth passenger the advantage of both. They should have provided further, that every guest of a hotel who might find an unoccupied room next to his own should be entitled to the use of the latter as a parlor without extra payment, and that to this end connecting doors should not be locked until such spare rooms are "required for use."

ACCORDING to the published proceedings of the Boston Board of Aldermen, for Jan. 9, that body wishes to dispose of "3,935 unserviceable water meters" and it invites bids for their purchase. As 3,930 of these are reported to be of the Tremont type, we probably see herein the end of the pretty little scheme of 1883 which has cost the City of Boston very considerable money. But while the meters themselves are fairly on the road to the dealers in "old junk," the fact that there was a bond attached to the original Tremont meter contract with the City, and that this bond has not yet been enforced, seems to have been overlooked. Why this very practical condemnation of the meter and this extreme mercy to the signers of the bond which guaranteed it?

Quick Confirmation.

In our issue of Dec. 31, ult., we discussed at some length the proper form of bridge guard-rails and what appeared to us defects in the recently issued circular of the Massachusetts Railroad Commission in regard to them.

Within three days after the article appeared, or on Jan. 10, there occurred an accident at Bradford, Mass., the most serious in that State (and almost in any other) since the Bussey bridge disaster—in which the importance of almost every point which we made was practically illustrated in what we trust will prove an effective way, and lead to the enforcement of those still further precautions for safety which are imperatively demanded, if the reasonable requirements are to be at all met.

We present in another column full details and illustrations of this accident, gathered on the spot by an attaché of this journal, which it is needless to recapitulate. The prime cause of the accident was to all appearance the use of stub, instead of split switches, again illustrating that discreditable tendency of the New England roads to continue the use of inferior appliances, rather than adopt better ones in time, which has received repeated illustrations, as notably at Revere and Bussey bridge. A split switch appears to be almost if not quite unknown on the Boston & Maine Railroad, which, in view of its wealth, heavy traffic, and vaunting ambition to control the whole mileage of New England is certainly amazing.

Precisely how the original breakage occurred is still doubtful. After the accident, the smoker was found derailed on the Merrimac river bridge with one wheel badly broken; some 16-in. of the flange having broken off; the breakage taking off enough of the tread to reduce it at one point to a width of 2¾-in. instead of 4-in., but in the main following the line of the tread, so as not to leave the wheel entirely unserviceable, but rather to leave it possible, if not probable, that it might have run in a broken condition for any part of the 33 miles from the last point of wheel inspection, or even longer. It is claimed by the railroad officials that the wheel was the sole cause of accident. This being rather a common way for wheels to break from original defect and rather an unusual one for a breakage from a flaw, we are inclined to think the breakage was in fact some miles old at least.

At whatever point on the road the wheel was broken, the claim that it can bear all the blame is hardly tenable. A stub switch in good condition and properly secured is not appreciably more likely to have its end broken by a bad wheel than is any other rail in the track. A wheel very badly broken may break or nick dozens of hundreds of rails in succession, as has been illustrated many times. If a wheel is not so badly broken as to nick or even mark any other rail in the vicinity, the chances are many to one against its *happening* to break that particular rail-end which is at a switch in good order. It is possible, in the sense that it is possible the sun will not rise to-morrow, but it is not a possibility which leaves room for a remarkable doubt.

The primary cause of the disaster then was, properly speaking, a partially displaced facing stub switch, whether the wheel had been broken before or not. Whether the rail-end broke the wheel or the broken wheel broke the rail-end, is a comparatively unimportant detail. The character of the fractures which we picture immensely favors the theory (1) that the switch-rails were displaced to the right perhaps only a little, (2) that the flange had been broken, in part at least, some time before, (3) that the broken flange hit the

inside corner of the main rail, broke it off, jumped across the head to the right, pressed the switch rail still further out of place, and left it in just the right position to have the other corner knocked off by the next following wheel in the curious way shown by our illustrations, which are made from sketches taken soon after the accident. This mischief once done, the switch was completely displaced and the next succeeding derailments of the three rear cars followed as a matter of course. The increasingly erratic path of each succeeding car needs no other explanation than the decreasingly inferior guidance of the car ahead. Ten persons were killed and 13 badly injured in these rear cars, which were stopped by wrecking a water tank.

The derailed smoker was dragged along at the rear of the baggage car for several hundred feet, rubbed against a fence standing some 5 ft. from the outside rail for about 100 ft., (knocking down the last part of the fence,) and was evidently steadied in some degree by its acting as a rude kind of outside guard-rail. The inside guard-rails were bent in merely to a junction, without any frog-point protection, and the importance of the latter was evidenced by the fact that one wheel at least seems to have split the guard-rails and run between them. In the main, however, the derailed wheels seem to have caught on the right side of the inside guard-rail, and the car was forcibly brought back so that it barely scraped the Phœnix column end-post of the bridge. It was still, however, completely and rather badly out of line, and bounced along over the ties for about 117 ft., very badly displacing them into bunches of three or four together with wide spaces between, (although this displacement was corrected very soon after the accident). At the last point of displacement the gap was so wide that the wheels dropped down enough between the ties to let the car fall over on its side until checked by falling against the side of the bridge.

The ties were 9 x 9, spaced 7 to 8 inches apart in the clear, extending the whole width of the bridge, new and of excellent quality. There were both inside and outside guard-rails. In fact the floor was in its main features up to the highest standard set by the circular of the Commission. In two details only did it fall below it,—the lack of a frog-point, before noted, and the very discreditable lack of proper notching of the outside guard-rail, or of packing blocks between the ties to prevent the ties being bunched. Instead of this, the guard-rail was merely bolted to every third or fourth tie, leaving the rest of the ties loose.

This is an important difference, to be sure, but even had this not been so, can there be a doubt that this accident shows the floor to have been an imperfect one? The mere fact that the heavy ties were spread as they were shows the tremendous blows which the wheels must have given them, for the same blow which tends to displace tends far more strongly to hold down in place. With ties only 2 to 4 ins. apart the displacement could not well have occurred. The effective way in which the car was brought partially back at the end of the bridge shows what inside guard-rails can do, and the imperfect work done by the fence shows the usefulness of some kind of outside guard-rail. Had there been both, the degree of control which was actually secured leaves it at least highly probable that a Latimer re-railing guard would have put the derailed wheels back upon the rails all right, for if *either* flange be intact that guard acts effectively, while the wheel tread was not so broken but that the wheel would keep the rail well enough for a considerable distance. Finally, the fate of both the smoker and the rear cars shows the great possible utility of having a heavy collision post planted at some distance from the bridge. The smoker would probably have missed it, but it was *almost* at the point where it was a choice between striking some such post and either knocking down the bridge or going into the river, or both. Is it necessary to have the course of events *precisely* such as to have the post a necessity, to have the moral appreciated? If so, we may find it perhaps in the fate of the rear cars. They were stopped very effectually by a water tank. They were too far from the river to have been in any real danger of running into it, but had the derailment been nearer to the river how far better to have been stopped even as they were than by a plunge into it?

It has been again and again illustrated that there is nothing like an object lesson of this kind on a large scale to enforce the importance of the best appliances. The Massachusetts Commission has always shown an enlightened disposition to insist on the use of the best only, so far as reasonable respect to vested interests and past customs would permit. We cannot but think that this last accident will lead them to feel that in their late circular they paid too much respect to the latter, and not enough to the requirements of safety, and that they will correspondingly modify their requirements.

Hardly had the preceding been written when news came from California of an accident on the Southern Pacific resulting wholly from the very cause on which we had commented in an editorial note in our last issue, the continued use of "straight-air" brakes on that road, despite the fearful warning of the Tehachapi accident, some years ago, in which a whole train-load of people were killed or injured.

In this case it was only a whole car-load. The North-bound express had just passed Sumner, Cal., when the rear car, an emigrant sleeper, broke loose from the train, and instead of the whole train being at once stopped, as it would have been by automatic brakes, the rear car dashed down the grade at a high rate of speed, and in a few minutes left the rails on a curve, rolled down a steep bank *took fire at once from the car stove*, and was a mass of flames before the train could back down to it. Fortunately there was no loss of life, as there were only 15 persons in the car, but several were severely burned or injured. "Thus hard is it," as we said last week about this very use of brakes, "to get the most ordinary and simple precautions adopted when past routine resists them."

There have also been four accidents this week on the elevated, two derailments, and two delays from break-downs, to illustrate in a measure what we said last week as to the great difficulties of continuing to operate that road safely under the existing conditions of overwhelming pressure of traffic. As a whole, this is a pretty good crop of "quick confirmations" for a single week.

The Pending Amendments Before the American Society of Civil Engineers.

We publish in another column a document which we are very glad indeed has been sent out, that, namely, issued by Mr. J. J. R. CROES and five other members of the above Society, stating that they propose at the coming Annual Meeting to offer amendments to the pending amendments, by which all provisions for the establishment of a junior grade called Students shall be striken out, the proposed change in the name and qualifications for the present Junior grade, however, (so as to make it an intermediate grade of Associate Members), and the proposed increase in qualifications for full membership, being left in.

It is well that the issue on this matter should be distinctly made, to the end that there may be the fullest possible discussion, and that the exact size of the party may be determined which is opposed to extending the usefulness of and interest in the Society by providing an appropriate place within it for engineers of *all* ages and grades of experience whose personal character is good. We cannot believe that the party amounts to more than a handful. In fact, of the six names signed to this appeal, we apprehend that half at least have been added under a misapprehension or merely on request, in order to bring the matter before the Society, and that they will not be found voting on the same side when the time comes for voting. Of one at least we know this to be so.

We have known for some time that some such effort as this was in contemplation, and in fact, have been surprised at not receiving some earlier evidence of it, but the time of sending out the circulars was at least well adapted, whether by intention or otherwise, to bring out all the opposition which exists in the Society, either by personal presence or by written communications, while leaving no time for any similar effort on the other side. Although dated Jan. 5, the circulars were not delivered until Jan. 9, leaving only seven working days before the meeting. This is not especially to be regretted, however, for it is not likely that the friends of this measure would have deemed the urgency great enough to send out any whipping-in circulars had there been a month of notice, and although the meeting under these conditions is quite sure to have a larger representation of the opposing element than would fairly represent the Society, both in respect to the attendance and the written discussions, yet it can do no harm to have this so, for it will require a clear majority of the Annual Meeting to defeat the measure, while it will require only one-third of the membership to defeat it on letter-ballot.

But while the appeal itself is well enough, there are certain features of it which require comment. In the first place, it clearly violates the spirit, if not the letter of the Constitution, by attempting to wholly prevent a vote on a proposition which was endorsed by vote of 4 to 1 at the last convention, and has since been unanimously recommended to ballot by a special committee. The Constitution says: "Proposed amendments * * * shall be in order for discussion at the Annual Meeting, and may be amended *in any manner pertinent to the original amendments*," being thereafter submitted to ballot. Is a motion to strike out altogether "pertinent to the original amendments"? Technically we presume it is, because the amendment makes certain other changes of a minor character in other clauses of the article. Practically it is not, because the proposition which it is proposed to strike out altogether is the end and aim of the whole amendment, and the plain intent of the Constitution is that any amendment which five members desire shall be first amended *as to form* and then submitted to ballot as to substance.

This point, however, will probably be waived by unanimous consent, for if the Annual Meeting represents the Society at all fairly, it will be easier to rally a bare majority of it in favor of the proposed measure than two-thirds of the whole Society in the subsequent ballot. We cannot doubt that it will be easy enough to do both, in view of the weakness of the reasons brought forward in opposition, which are these:

"Strike out entirely the clause in italics [creating the grade of "Students"]. This Society is *not an institution for primary education* [all italic ours. ED.], but is intended to be an association of *skilled and experienced* engineers for mutual improvement by the interchange of ideas and experiences of a character more advanced than can be *fully* understood by novices in professional work. Admission *to any grade* of membership should be contingent on experience had, and work accomplished, and *not on the mere desire to learn and the hope of future benefit by association.*"

In this last sentence we have the issue clearly drawn. Is it, or is it not, the view of a majority of the Society that "the mere desire to learn and the hope of future benefit by association," combined as it must be of necessity with good moral character and standing and a certain minimum of study or experience, is an insufficient qualification for admission to *any* grade of the Society, either actual or potential? To the vast majority of the Society such a question will almost answer itself. If the "mere" "desire to learn and hope of future benefit" are not a sufficient qualification for the limited privileges which it is proposed to grant to these "novices in professional work," what in the name of common sense would be sufficient grounds for such gracious favors? What are these privileges? They may be all listed thus: (1) To pay $6 to $10 per year, (2) to receive the printed publications of the Society, (3) to present papers and *written* (not oral) discussions, which if deemed worthy will be printed and if not will be waste-basketed; (4) to have their names and addresses printed in the Society lists in a separate roll; (5) to use the library and rooms of the Society to the extent and in the manner which the Board of Direction approve of from time to time; (6) to *attend* (not take part in) certain of its meetings subject to the same provisions, until such time shall come that the Board thinks it better to provide for special meetings of Students, as in England, and to exclude them altogether from the regular meetings. Even these privileges no one can obtain if a single member of the Board of Direction objects, and he holds them only during the will of the majority of that Board or until attaining the age of 27 years, when they cease abruptly, and he is dropped from the rolls of the Society, unless he has previously been elected to one of the permanent grades.

Surely he must have a somewhat dog-in-the-mangerish disposition who can in cold blood —and realizing what he is doing—object to the granting of such limited privileges as these to every properly qualified and vouched for applicant who wants them, and is willing to pay for them. If it will in fact make the Society "an institution for primary education," or for any other kind of education which it is not now, so much the better. The gentlemen who issue the circular boldly assert that that is not a purpose of the Society, but unless it can be shown that it will not tend to "the advancement of engineering in its several branches," or will do more than corresponding damage to the other work of the Society, we are compelled to differ from them. To assert that it will do such damage, as for instance, tend to "dilute" the Society, is indeed possible, but only by ignoring plain facts. On the contrary, a chief merit of the proposed measure is that it will make it possible to maintain, *what is not now maintained*, a really high standard for admission to the higher grades. The "dilution" comes in in attempting to crowd all grades of experience into one or two grades, as the only alternative to excluding altogether, and it has had, and will continue to have, unless corrected, a very injurious effect upon the standard for full membership.

The apparent intent of the allusion to "primary education" is to create prejudice, by insinuating what it would be hopeless to attempt to prove in plain words; like the "boy's school" charge which has once before been brought forward. The writers however forget, or hope that others will, that the class for whom the grade is intended, those between 18 and 27 years of age, are not boys, but hard working and struggling young men, few of them backed by much money, who have their own way to make in the world, and whom any right feeling man should be glad to assist by any means in his power, knowing, as most of us should, that he will find the road to any high standard of professional qualifications long enough and hard enough at best. They also forget, or hope that others will, that the same grade is one of old standing in the Institution of Civil Engineers, that it has been an immense success, is nearly as large in numbers as the grade of Member, and is universally approved of, so that if its creation will in fact tend to make the American Society "an institution for primary education" (granting for the moment that that would be objectionable) the Institution is such already. Therefore, in view of the comparative standing, influence and work of the two organizations, we cannot but think that anything which assimilates the two to each other may be borne with equanimity by the American Society at least. We do not forget, on the contrary we have carefully weighed, the alleged differences of conditions between those who enter the Student class in England, and those who would enter it here. Some differences of conditions are inevitable between two countries 3,000 miles apart, but "blood is thicker than water" and we are satisfied that the differences are superficial and the resemblances fundamental. Because the parallel is not exact, which no parallel well can be, it is not rational to ignore wholly the plain teachings of so important and so encouraging a precedent; especially as it has been repeated right under our nose within the past two years in the Canadian Society of Civil Engineers, in which the Student grade is a very important and growing feature, under conditions so similar to our own that the differences are not worth mentioning.

The declaration of the purpose and character of the Society is also quite different from anything contained in the Constitution, in alleging that it is only intended for "skilled and experienced" engineers. On the contrary, the Constitution implicitly declares that all engineers "shall be eligible *in their appropriate class*" and the argument that the "ideas and experiences" presented before the Society are "of a character more advanced than can be fully understood by novices in professional work," is likewise a weak one indeed. Supposing that these very advanced ideas are not "fully" understood, what is the harm of allowing young men under 27 to sit quietly by and absorb as much of them as their limited faculties will permit? But the assertion itself could only be made in forgetfulness or ignorance of fundamental laws of the mind. At no time in an average life is the mind in better, or as good condition, to assimilate and profit by *the ideas and experience of others* as at that very age. Our mental faculties reach their highest power for original work at a much later age, because the teachings of personal experience are vastly more valuable than even those "advanced ideas" which are interchanged at the Society meetings, but in proportion as the internal resources of the mind become developed, its merely absorptive and assimilative faculties become dwarfed (often painfully so) so that no average man's mind is ever again in condition to *gain* as much from merely listening to or reading of the ideas and experiences of others as at these very ages which it is proposed to exclude altogether from the Society meetings and mailing lists.

The very men who are urging this reactionary policy do not realize what they are doing or they would not do it. We have noticed the matter at some length, however, as the only means in our power to counteract the possible effect of their carefully timed circular to bring out an entirely one-sided expression of the real feeling of the Society, and because more no-such-things can be asserted in five lines than can be disproved in as many pages. We can only urge in conclusion that every member, of whatever way of thinking, who can possibly arrange to attend the annual meeting should do so, in order to bring out a true expression of feeling in regard to the important amendments to be acted on, which will profoundly affect, for good or bad, the future of the Society and the profession.

CORRESPONDENCE.

Unsymmetrical Sections.

BROOKLYN, Jan. 10, 1888.

EDITOR ENGINEERING NEWS:

It may be useless to prolong the discussion about the heresy (if I may so call it) of Mr. T. H. JOHNSON, relative to the equilibrium of forces, but it has seemed to me that, by putting it in a different way, I can possibly make a little plainer the error under which he is laboring.

I take it to be the very *A. B. C.* of theoretical mechanics that it is necessary for the equilibrium of a system of forces acting in a plane:

First. That when the forces are decomposed into components in the directions of the axis of *X* and the axis of *Y*, the algebraic sum of the forces in the direction of each axis shall equal zero.

Second. That the sum of the moments of all the forces about any point in the plane shall also equal zero.

It is also true, when stated thus generally, that the second condition of equilibrium includes the first; *i.e.*, if the moments of the forces balance each other *wherever* the centre of moments may be taken, then the sum of the components in each of the two directions must necessarily equal zero. And this may be what is misleading Mr. JOHNSON, as he is undoubtedly right in saying that "equilibrium is only possible when the moments of the forces are equal,"—the only trouble being that he ignores a part of the forces.

If, however, a definite fixed point be taken in the plane, the forces might be such that their moments about this point would balance each other, and there would be no tendency to motion of rotation about it; and yet condition (1) might not be satisfied, and there could then be no complete equilibrium, but a resulting force tending to produce a motion of translation of the fixed point.

Condition (1) can also be easily satisfied without satisfying No. 2, in which case there would be a motion of rotation without translation.

Now if in the case of a beam, the numerical moments of the tensile and compressive forces on each side of the neutral axis of any section are assumed to be equal, instead of the forces themselves, there must in unsymmetrical sections be a resulting force acting longitudinally with the beam at the neutral axis tending to produce a translatory motion in the same direction as this resultant,—only resisted by friction of beam on its support. And if so resisted, as this resulting force acts at the *supposed* neutral axis, what is to prevent its compressing or extending the fibres at this point, when it would necessarily cease to be a neutral axis.

Moreover may I ask what is the theoretical necessity that the moments of the tensile and compressive fibre strains of any cross section of the beam about the neutral axis *should* be equal. I can see no analogy between these forces and the principle of the common balance. In the common balance, or lever with the fulcrum between the acting forces,

the forces must not only be reversely proportional to their lever arms, but also must *act in the same direction.* How is it in the case of these tensile and compressive fibre strains? They do not act in the same but in *contrary* directions;—hence there can be no equilibrium of moments of these forces about the supposed neutral axis, whether they are *numerically* equal or not they both tend to produce a motion of rotation in the *same direction*,—or more properly speaking, to resist the rotative effect of the external forces. And this motion of rotation takes place until these fibre strains are developed sufficiently for the *sum* of their moments around the neutral axis to be equal to the opposing moments of the external forces,—the applied loads and the reactions on the points of support.

I have only for simplicity considered the forces acting in a single plane. In point of fact they act in a series of parallel planes, which does not affect the argument.

To sum up, there can be no necessity for the moments of the compressive and tensile fibre forces of any section being equal. If they are equal, these moments are *not* in equilibrium with each other, but in any case their sum must be in equilibrium with the moments of external forces.

It may be that the neutral axis in some cases is not in the centre of gravity of the section,—it may be that our theory of the flexure of beams may have to be modified,—that equal strains do not always compress and elongate the fibres equal amounts, especially in such unsymmetrical shapes as L s and T s,—or that longitudinal or diagonal shearing strains will have to be considered; but I cannot see how making these tensile and compressive moments,—which never can balance each other,—always numerically equal, and thereby in unsymmetrical sections leaving a resultant force of translation, is going to improve the theory.

J, F. FLAGG.

DEFIANCE, O., Jan. 9, 1888.

EDITOR ENGINEERING NEWS:

In the controversy between Mr. THOS. H. JOHNSON and Prof. DU BOIS it is difficult to understand Mr. JOHNSON'S reasoning. I would like to inquire why it is necessary that the moments of the internal forces of tension and compression should be equal as between themselves when they both tend to turn the section in *the same direction*? The outer forces of course tend to turn the section in the opposite direction, but Mr. JOHNSON says nothing of this.

Yours truly C. H. LINDENBERGER.

Strains in Pins.

COLUMBUS, O., Jan 2, 1888.

EDITOR ENGINEERING NEWS:

There was recently called to my attention the case of a bridge of doubtful quantity, where two bridge experts, of acknowledged ability, were called upon to calculate the unit strains and details of the structure, unknown to one and the other.

In the case of the pins, one reported a fibre strain of 20,000 lbs. per sq. in. and the other of 100,000! Why this disagreement?

While I am not aware of the methods used by either, it is to be supposed that both used the formula usually stated for finding the bending moment of pins.

One must evidently have used the strains as they co-exist, for one position of the load, disregarding impact, and taking the load in the position giving maximum resultant moment; while the other very likely took maximum strains for each piece, including impact, and disregarding their co-existence, While the latter method will, as I am aware, give a greater fibre strain than the former, it will hardly account for the great difference given.

That the formula in use will in many cases give a fibre strain of upwards of 100,000 lbs, I have found in my own experience to be true.

Mr. EDWIN THACHER, in his discussion of the Wilson specifications, mentions having found pins in the same condition, and such is the experience of most all engineers who are engaged to any extent in bridge work.

In the analysis of pins by Mr. CHARLES BENDER, it is stated:

"A pin is nothing but a beam, and since a great variety of experiments, made on beams, prove that within the limits of elasticity the theory adopted is not less correct than the law of gravitation to the movements of the planets, what remains to be done is: only to find theoretically the maximum strains at different points of the pin."

While the theory of the elasticity has been proven correct, this fact certainly does not prove that it is applicable to the case under consideration.

Indeed, its applicability *may be doubted* in many cases, as has been developed during the recent discussion in your columns on the "Compression Members of Bridges."

The pins with a fibre strain of 100,000 *lbs. still do their work in defiance of the pin formula.*

The only explanation of the matter I have known to be offered is in Stoney, Article 461:

"Pins may fail from bending. This also arises from its diameter being too small to afford the requisite stiffness, but ultimate failure may be prevented by the links being kept from spreading asunder by head and nut on the pin, at the loss, however, of freedom of motion."

It may well be asked, is the excessive service rendered by the pins mentioned due to their being retained in place by the nut or being closely and firmly packed together?

The problem certainly is one of great complexity, where there are a dozen or more pieces meeting on the pin at different angles, some not having a full bearing, some bearing on one edge only, some, as in cases I have seen, being so long as to never have a bearing, even when the heaviest loads are on the structure, others unequal moduli of elasticity and still others unequal coefficients of expansion.

While calling in question the correctness of the methods, in that they do not agree with pins in use, and having, no doubt, the size of pins now used by the best bridge builders, makes them amply strong, are they stronger than necessary?

Is any other explanation to be offered than that just given from Stoney?

If this is the true explanation, then it would seem to be a waste of time to calculate pins by taking account of flexure, when they have bars, packed upon them and retained by a nut.

In lieu of any experiments in this direction or further explanation, it would certainly be a profitable supplement to the way pins are treated in the text books, if some persons would give exposition of some of the methods in use by our prominent bridge companies, as the text book method is, as any one who has used it can testify, very laborious and unsatisfactory. That there are various modes of treatment is evident from the results stated.

Yours truly, C. E. FOWLER,
Asst. Eng. C. H. V. & T. Ry.

[Who shall decide when doctors disagree? No one imagines, we suppose, that pin strains are susceptible of very rigorous analysis. The only rational basis is to make the most unfavorable possible assumptions and proportion the pins accordingly, a basis which would appear to have been conspicuously violated in computing the lower strains above, although the latter may have come nearer to the actual strains for the time being. ED. ENG. NEWS].

Population of the Country about Kansas City.

The *Kansas City Times* publishes a map of the country surrounding that thriving village and sets forth statistics showing that, "the country within a radious of 62½ miles of Kansas City contains a larger population than the same extent of territory around any city in the union." The population claimed for this area exclusive of the city itself is 738,160: and figures are given for the population surrounding the once prosperous cities of Chicago, St. Louis, Minneapolis and St. Paul to show the truth of the assertion. We have not the statistics at hand to verify the above statement as regards the cities of the West, and will not attempt to uphold the relative greatness of Kansas City's neighboring rivals, whose defenders are seldom found silent when anyone challenges their city's importance. But with all due respect to the population "within 62½ miles of Kansas City" and to those who thus argue its greatness, we would respectfully remind them that when the great exodus to the Missouri river metropolis occured, a few people were left behind in the East. If a 62½ mile radius were described from the point where this article is written, the population which would be included besides that in New York City would far outnumber the "738 thousand paraded above. If we go up to the ancient and respectable city of Boston, we find a 62½ mile radius including dozens of big and little cities whose total population foots up to a rounder sum than our Kansas City advocate claims. In fact one might find it difficult to describe a circle 125 miles in diameter in eastern Massachusetts or Connecticut and possibly in some parts of Pennsylvania or New York with less than the above number in its limits. We have no wish to contradict the real estate boomer when he chants in Mohammedan fashion "great is Kansas City;" but when figures are exhibited and statistics quoted in support of a false statement, there is pleasure in touching the bubble and explaining its flimsy nature.

Foreign Technical Items.

The Senate of Buenos Ayres has been considering the question of selling the Central Norte Railroad. The maximum price is fixed at $15,000,000. The State guarentees 5 per cent. interest.

The Sultan of Turkey has named an engineering commission to comsider a plan for making Lake Van, in Asia, navigable.

The sewerage system now being introduced in the City of Tunis will involve the disinfection of a lake which has been an uncleaned reservoir during the last 1,000 years.

Offers for improving the port of Pernambuco, must be sent to Washington Legation of Brazil before Jan. 31, 1888.

ON some of the French canals the vegetation is kept down by the use of V-shaped scythe's, each dragged from a boat by a chain attached to the point of the V. Each leg of the V is 4½ ft. long and the total weight is 50 lbs. The scythe must be raised and resharpened about once an hour. Two men and one horse, on a canal 33 ft. wide can deal with from 15 to 16 miles of canal in one day. The whole apparatus costs about $800, says London *Engineering.*

Height and Volume of Dry Land: Depth and Volume of the Ocean.

At the last meeting of the Royal Society of Edinburgh, Dr. JOHN MURRAY, of the Challenger Expedition, made a communication on "The Height and Volume of the Dry Land and the Depth and Volume of the Ocean." According to his own investigations, the mean height of the land of the globe was 2,230 ft. above the sea level, and the mean depth of the ocean was 12,480 ft., or 2,080 fathoms.

If the ocean were regarded as being divided into two parts by the 1,000-fathom line, it would be found that the mean depth of the area having less depths than 1,000 fathoms was 2,028 ft., or 338 fathoms, or nearly the same depth beneath the sea as the height of the dry land above it. On the other hand, the mean depth of the area beyond 1,000 fathoms is 14,640 ft., or 2,440 fathoms. The former area—called by Dr. MURRAY the "transitional area"—occupies 24,000,000 sq. miles; and the latter area, which is the abysmal area, and is situated fully three miles below the average heights of the continents, occupies 113,000,000 sq. miles, or more than half of the surface of the earth.

In the transitional area of the ocean there are many and varied conditions in respect of light, heat, currents, changes of level, the character and variety of the deposits, and in the animals and plants which inhabit the various parts of the region. The deposits are in most respects similar to those which make up a very large part of the sedimentary formations of the dry land. In the abysmal area there is a uniform set of conditions, the temperature being near the freezing point, with an annual range not exceeding 7 deg. Fahr., and there being no sunlight or plant life. There is a great abundance of anima life, but the forms from various parts of the area are very similar, and unlike those of shallower waters and the deposits, which accumulate slowly, are unlike any of the sedimentary deposits of the dry land.

From Dr. MURRAY'S investigations, it also appears that if the dry land of the globe were reduced to the sea-level by being removed to and piled up in the shallower waters of the ocean, then its extent would be about 80,000,000 sq. miles, and the rest of the surface of the earth would be covered by an ocean extending to 113,000,000 sq. miles. Again, should the

whole of the solid land be reduced to one level under the ocean, then the surface of the earth would be covered by an ocean with a uniform depth of about two miles.—*Engineering*

Boston Heating Co.

This plant, of which a full description was given in ENGINEERING NEWS of Nov. 12, 1887, is now in operation and, although not yet in full operation, the following additional particulars are given. Four of the Heine boilers, comprising 400 H. P., are under steam, six have been placed in position and six more are to be erected at once. The pressure carried is 200 lbs., at which point the safety valves are set to blow off. The coal used is pea and dust, about 4 tons are burned in 24 hours. Two large fan blowers are in position but are not required at present. The boilers make some smoke, and the height of chimney, 30 ft., appears to be inadequate for complete combustion, although the use of the blowers will probably improve the plant in this respect.

The hot water pressure is on 13,000 ft. of pipes, and no melting of snow above the pipes is noticeable in the streets. The pressure of water in the pipes and circulation is maintained by one pump at present, there being about a dozen takers, exclusively for heating purposes, thus far. Three pumps are in for circulating and three for pumping the return water back to boilers. The hydrostatic pressure of the outflow into circulation is 300 lbs. per sq. in., and temperature 368° Fah. The pressure of the return water is 175 lbs. and temperature 325° Fah., 125 lbs. reduction in pressure and 38° Fah. loss in temperature, representing the work done in circulating and the heat consumed in heating the various buildings where the system has been introduced.

It is stated that before doing any commercial heating the reduction in pressure due to the circulation alone was 30 lbs., representing the friction losses. The plant is provided with electric arc lighting by independent dynamo run by an Armington & Sims engine. The steam for running the engine and pumps is obtained from steam drums over the boilers, the water level being carried some distance up in the drums above the tubes, in the Heine boilers. The outflow pipes leave the boilers below the water line at back end, the return pipes entering at about the water level in front.

It is to be hoped that careful tests will be made of the efficiency of this rather novel system, as a matter of engineering and scientific interest. Where eminent mechanical engineers differ so radically as to the advantages or disadvantages of this method of heat and power supply, nothing but the facts, carefully ascertained, will be satisfactory to the engineering public.

The district covered by the pipeage put in contains about 1,000 buildings with an estimated inside space of 130,000,000 cu. ft. to heat. It is estimated that 10,000 H. P. will be ultimately required to supply the heat and power, including cooking, of the district.

ACCORDING to a German authority the blues of a drawing made in Indian ink can be prevented from washing down in the process of coloring by mixing the ink with a two per cent. solution of potassium bichromate, instead of ordinary water. The potassium bichromate, under the action of light, forms an insoluble compound with the size with which the ink is prepared, and in this way the desired object is obtained.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(*Specially Communicated.*)

Portage, Wis.—The works were commenced July 20, 1887, and completed Dec. 20, 1887; they were designed by E. G. FERRISS, who was also Constructing Engineer. The contract for the entire works was taken by Moffett, Hodgkins & Clarke, of Watertown, N. Y.; the contractor for the buildings was Peter Mills, of Portage; for pumping machinery, Henry Worthington, of New York; for pipe and specials, Warren Foundry & Machine Co., Phillipsburgh, N. J., and Lake Shore Foundry, of Cleveland, O.; for valves and hydrants, Ludlow Valve Co., of Troy, N. Y.; for stand-pipe and reservoir, Riter & Conley, of Pittsburg, Pa.; the masonry, foundations, trenching and pipe laying were done by day labor under the direction of the engineer. The stand-pipe is 25 ft. diameter and 80 ft. high, situated at an elevation of 70 ft.; the top being 150 ft. above the tower; it is of steel plates from $\frac{5}{16}$ to $\frac{1}{4}$ in. thick. The franchise is for 20 years and the price per hydrant for 75 hydrants is $40. The franchise is owned by the Portage City Water-Works Co.; President, E. G. FERRISS; Secretary, C. F. MOFFETT; Superintendent, JAS. W READE. The present population is estimated at 5,800.

EDITOR ENGINEERING NEWS: The water-works at this place were tested by the city fire department Dec. 17; the test was 6 streams 90 ft. high from separate hydrants, all to be maintained for 1 hour. The streams were held at something over 100 ft. The machinery all worked first rate and the people were most pleased. The City Council held a special meeting Dec. 20 and unanimously accepted the works. The water is taken from the Wisconsin river about $1\frac{1}{2}$ miles above the town, filtered through 50 ft. of broken stone and gravel to a double flume under the pump house. The flume is of wood with separate gates to each apartment, with a sponge filter in each, which can readily be taken out and washed. There are 2 Worthington pumps, one high pressure, $18\frac{1}{2}$-in. steam cylinder, 12-in. water cylinder, 10-in. stroke; the other compound, 12 and $18\frac{1}{2}$-in. steam cylinders, 12-in. water cylinder and 10-in. stroke. Two boilers 60 ins. by 16 ft., with 48 tubes 4 ins. diameter. The smoke-stack is of brick, 60 ft. high, flue 28 ins. square.

An intake pipe 14 ins. diameter is run out through the bottom of the filter into the channel of the river, with the outer end turned down stream; the inner end with gate inside of flume. The blow-off from the force main is run into this intake so that the water can be drawn off from the pipes and tank out in the river where it can do no damage and the intake thoroughly flushed out at any time. The Wisconsin river is worse than the Missouri in regard to changing channels, and any obstruction put on the bottom will in a few days be covered with sand. To avert this I built my filter bed with hard bottom, and carried my intake above the bottom on oak piles only 2 ins. thick set edgewise in the current so that the water sweeps the bottom under the pipe. By turning the pipe down stream no sand enters it, and if any should enter it can be flushed out with the blow-off. This has been in some months and works well so far, the bottom keeping quite clean under the pipe.

The water is pumped through a 14-in. and 10-in. main to a tank 25×80 ft., the bottom of the tank is about 70 ft. above the pumps. The pumps are about same level as business portion of town, so that we have a tank pressure of 150 ft. There is an electric valve at the tank operated from the pump house so that direct pumping can be carried on at any time when required. There are $7\frac{1}{4}$ miles of pipe; and 70 double nozzle fire hydrants. The city pays an annual hydrant rental of $3,300 on present number of hydrants, and $40 per hydrant for any additions which may be made hereafter.

E. G. FERRISS.

Seabright, N. J.—The water-works were commenced in December, 1887; 3 wells are bored and the pump house is completed; they were designed by CHAS. H. DEDERER, who is Constructing Engineer. The Hall Steam Pump Co., of New York, has the contract for pumping machinery, and the Cunningham Iron Works, of Boston, for the stand-pipe, 80 ft. high. The prices paid are $1.50 per ft. for trenching and $1.75 for pipe laying. The masonry, foundations and buildings are done by day work. The works are owned by the Seabright Water Supply Co.; President and Superintendent, CHAS. H. DEDERER; Secretary, GEO. W. ELLIOTT. The permanent population is estimated at 800 and the summer population at 3,000.

General Description of North River Bridge.

(*See Inset.*)

The principal dimensions of the proposed bridge may be roughly summarized thus: 145 ft. clear height at 50° F. at middle of river. Rise and fall of floor nearly 4 ft; in other words height will be 8 ft. more in January than in August. Length of middle span 2850 ft. centers of towers; length of end spans, 1500 ft. each; total length, including anchorages, nearly 6500 ft. Height of towers, 400 ft. to lower cable and total height 500 ft. Towers will stand on masonry piers, 340 ft. long, 180 ft. wide and 25 ft. high above high water. Depth of foundation on New Jersey side 75 ft. and on New York side about 180 ft. The towers are wrought iron and steel; there are 16 columns in each tower, or 8 under each arch support. These columns are of angles and plates; are octagonal in shape, and taper from 7 ft. in diameter at the bottom to 5 ft. at top. They are strongly braced together, inside, with heavy bracing, and outside with a large sized latticed filling. The form of the towers is chosen with regard to appearance and to greatest stability in case of tornadoes striking the bridge. The anchorages are each 320 ft. long, 210 ft. high above pavement and 180 ft. wide at the base. The six railroad tracks pass through a tunnel in each anchorage.

The type of the superstructure is that of two inverted huge braced arches (formed of steel wire cables), supported on the metallic towers, from which they descend to the large anchorages, which resist the pull from the arch cables. The cables are 50 ft. apart, strongly braced together to resist the deforming effects of trains. Each cable has an outside diameter of 4 ft., and will have a smooth cylindrical appearance. The cable section is divided in four quarters, to facilitate connection with webmembers and lessen inequalities of temperature. The steel wires forming the cables are inclosed in steel envelopes, which protect them absolutely against rain and weather. An air space of 2 ins. is left between the steel envelopes and the wire, for better protection against the heating of the sun. These mammoth cables rest on balancing platforms in the cable chamber on top of the tower. These chambers are 35×35 ft. by 70 ft. high. These balancing platforms take the place of end-hinges, so that the arch-ribs will in all respects be like inverted end-hinged arches. There is also a hinge equivalent arrangement in the anchorages. The end-spans are provided at the middle with anchor-trestles, whose office is to prevent too great deflections from concentrated loads on the end-spans; they bear no part whatever of the dead load of the superstructure. The arches are designed to resist, unaided by the stiffening girder, all effects from transient loads. The platform is 86 ft. wide (same width as East River Bridge), but has only two stiffening trusses, between which the six tracks are located. The tranverse floor-beams are suspended from tranverse girders overhead.

The stiffening trusses are merely auxiliary, and are principally designed to form the frame work for two large horizontal wind trusses (top and bottom of platform) which in combination with four wind-cables, $12\frac{1}{2}$ ins. diameter, will make the bridge safe against the most violent tornadoes.

The wind cables will, by a peculiar arrangement, be always in tension, irrespective of the season of the year, and therefore ready for instantaneous resistance against wind pressures.

The bridge is designed for the heaviest trains which it is possible to pull up to the bridge over the steep grade of the approaches, (steepest grade will be $2\frac{1}{4}$ per cent.) equivalent to a load of 12,000 tons concentrated in a length of 1,500 ft. The entire bridge is so designed that four additional railroad tracks can be placed on it at any time in the future, if it should become necessary, making a double deck bridge. For ordinary every day travel the bridge will be strained only to about 10 per cent. of the maximum load for which it is designed.

Still Greater Prosperity Predicted.

Judging from observation and the expressed opinions of the leading business men of the South, we think it perfectly safe to predict a greater activity in general business for the coming year than we have had for the year that is just closing. There is not a single enterprise that has been inaugurated during the present year that is showing any signs of weakening; on the contrary, as the year approaches they are giving signs of still greater efforts on the part of owners to push them to early completion and get ready for active business. The tightness of the money market that has prevailed through the South for the past few months has had the effect of causing many to look forward to the future and to be more guarded in their financial operations. It is a fact that many large manufacturing concerns have found it difficult to call a halt at the closing of the year sufficient to get their books and stocks in such a shape as to see how things stand in consequence of such large volumes of orders that have been coming in, thus as it were running one year into the other. Hundreds of half finished jobs and the taking of new contracts are not very convenient items for the book-keeper to handle. There is going to be a much greater amount of building done the coming year than in the past. Dwelling houses in particular will form a very large item, but warehouses and stores will also be built in great numbers, to say

nothing of the buildings for the manufacturing plants that will be erected. Another item conducive to business activity will be the construction of a number of new lines of railroads. While it is true that an almost unlimited number of railroad charters have been granted, it is equally true that quite a number of them will assume shape during the coming year and be completed in the course of time.—*Iron Age.*

PERSONAL.

JOHN P. ADAMS has been appointed Commissioner of City Works, Brooklyn, N. Y., to succeed GEO. R. CONNER.

M. J. BECKER, Chief Engineer of the Pittsburg, Cincinnati & St. Louis R. R., has removed his office from Columbus, O., to Pittsburg, Pa.

A. H. SALISBURY has been elected Superintendent of Water-Works at Lawrence, Mass., for 1888. JOSEPH E. WATTS is President of the Water Board.

R. E. RICKER, Chief Engineer and General Superintendent of the Denver & Rio Grande R. R. has resigned. R. E. BRIGGS, of Pueblo, Col., will be Chief Engineer, and S. T. SMITH, General Manager, will be General Superintendent in addition to his other duties.

Maj. Gen. ISAAC R. TRIMBLE died recently at Baltimore, Md., at the age of 86. He was Chief Engineer of the Northern Central; Philadelphia, Wilmington & Baltimore and Boston & Providence railroads in their early days. He saw considerable service in the Confederate army during the war. He took part in PICKETTS charge at Gettysburg, and there lost a leg and was taken prisoner and kept at Johnston's Island and Fort Warren until February, 1865.

C. M. BISSELL, Superintendent of the Harlem division of the New York Central & Hudson River R. R., has been appointed Superintendent of the division between New York and De Witt (to be known as the Mohawk and Hudson division), with office at Albany. J. H. PHYE and F. H. PHILLIPS are Assistant Superintendents at the Grand Central Station and Little Falls respectively. GEO. H. WORCESTER has been appointed Superintendent of the Harlem division.

J. J. MCVEAN, Chief Engineer of the Detroit, Lansing & Northern Railroad, has been appointed Chief Engineer of the Chicago & West Michigan Railway, controlled in the same interest. Mr. MCVEAN succeeds Mr. J. W. PETHERAM, who has been appointed Lumber Agent of the Chicago & West Michigan, with headquarters at Grand Rapids. He will have charge of the purchase and inspection of all lumber, timber, ties, and wood used by the company.

CALVIN A. RICHARDS, formerly Superintendent of the Metropolitan Street Railroad, Boston, Mass., and late General Manager of the West End Railroad, has resigned.

FREDERICK MERCUR, General Superintendent of the Lehigh Valley Coal Co., died at Wilkes-Barre, Pa., Jan. 11, at the age of 51. He was chief of the engineering and construction department of the Lehigh Valley R. R. Co., and built the line from Penn Haven to Wilkes-Barre. In 1867 he became General Superintendent of the Lehigh Valley Coal Co.

Col. MARSHALL MCDONALD and Dr. JEROME H. KIDDER are the two principal candidates for the office of U. S. Fish Commissioner to succeed the late Prof. SPENCER F. BAIRD. The former has been connected with the U. S. Fish Commission since 1879, and is especially prominent for the valuable work he has done in Pisciculture. Dr. KIDDER is the present Assistant Commissioner and has an excellent record for original scientific work in many branches.

JAMES WALSH OTLEY, C. E., died at Des Moines, Ia., Jan. 2, at the age of 68. He was born in Skelton, Yorkshire, England, Jan. 22, 1820, and grew up to manhood in Darlington. He received a liberal school education in England, and early in life chose to become a civil engineer. He came to the United States in 1848, and in October, 1856, came to Iowa. He made the first official plat of the town of Keokuk and lived there for many years. He was employed to survey the Des Moines Valley Railroad, and started out with chain and compass to traverse the country along the Des Moines river and lay out a railroad over the prairies. That portion of the road from Eddyville to Fort Dodge was surveyed by him and built under his personal supervision. For many years after the construction of the road he was chief engineer. He was one of the few remaining engineers who surveyed the pioneer lines of road across Iowa and gave to the geography of the State a permanent shape. He afterwards embarked in other business, but not making a success at it he has for the past 10 years lived a retired life at his home.

He was a pioneer in railroad engineering having commenced the practice of the profession about 1837 with his father, Mr. RICHARD OTLEY, then president and subsequently chief engineer of the Stockton & Darlington Railway, the first empowered by special Act of Parliament to operate a line by locomotive engines. He was an eye witness to the opening of that railway and, although only 5 years old at the time of its occurrence remembered seeing Stephenson's engine and also the man on horseback who rode in front of it carrying a flag.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—The following circular as to the proposed amendments to the Constitution, dated January 5, but only delivered in New York January 9, or nine days before the Annual Meeting, has been sent out to members:

To Members of the American Society of Civil Engineers:

The undersigned, Members of the Society, give notice that at the Annual Meeting on Jan. 18, 1888, they propose to offer the following amendments to the "proposed amendments" to the Constitution, for submission to the Society. They request that all members who can possibly do so, attend the Annual Meeting and vote upon these amendments, and that members who cannot be present, send at once to the undersigned or the Secretary of the Society, their views on the amendments, to be read in the discussion which will take place on this subject at the Annual Meeting, and be printed for the information of members—J. J. R CROES, WM. R. HUTTON, J. F. FLAGG, G. LINDENTHAL, C. C. SCHNEIDER, JAS. ARCHBALD.

The first Amendment as originally offered was for Article XVI. of the Constitution, to read as follows:

CONSTITUTION.—*Article XVI*—The active members of the Society shall be divided into three classes, to be styled respectively Members, Associate Members and Associates; and each person, when duly elected and qualified, shall receive a certificate of Membership indicative of the class to which he belongs.

Associate Members shall have all the rights and privileges of Members excepting the right to hold office or to vote upon admission to membership or changes in the Constitution and By-Laws of the Society. Associates shall have all the rights and privileges of Members excepting the right to hold office or to vote.

There shall also be a preparatory grade, to be designated Students of the Society, who shall have the right to receive the Transactions of the Society and to present papers and written discussions. They shall also have the right to use the library and rooms of the Society, and to attend its meetings subject to such regulations and restrictions as the Board of Direction may adopt.

Members of the Class previously styled Juniors, shall after March 7th, 1888, be classed as Associate Members.

Proposed Amendment of above:—

Strike out entirely the clause in italics. This Society is not an institution for primary education, but is intended to be an association of skilled and experienced engineers for mutual improvement by the interchange of ideas and experiences of a character more advanced than can be fully understood by novices in professional work. Admission to any grade of membership, should be contingent on experience had and work accomplished, and not on the mere desire to learn and the hope of future benefit by association.

The second Amendment, as originally offered, was for Article XVII. of the Constitution, to read as follows:

Article XVII.—A Member shall be a Civil, *Military, Mining or Mechanical* Engineer, not less than 30 years of age who has been in active practice *as such* for at least ten years, or has graduated at a School of Engineering and been in practice *seven* years, and who has had responsible charge of work as Chief, *Resident,* or Superintending Engineer for at least two years, not as a skilful workman merely, but as one qualified to design as well as to direct engineering works.

An Associate Member shall be one not less than 24 years of age, who has had actual practice in some of the branches of Civil, *Military, Mining or Mechanical* Engineering for at least five years, or has graduated at a school of Engineering and been in practice two years and who continues in actual practice at the time of his application for membership.

An Associate shall be one not less than 25 years of age, *who is a manager of a railroad, canal or other public work; a geologist, chemist or mathematician; a proprietor or manager of a mine or metallurgical works; an architect or a manufacturer; or one* who, from his scientific acquirements or practical experience, has attained eminence in his special pursuit, qualifying him to co-operate with engineers in the advancement of professional knowledge; but shall not himself be practicing as an engineer.

A Student shall be one not less than 18, nor more than 27 years of age, who is engaged in the study of Engineering with the intent to become an engineer, and who has pursued that study at a technical School not less than one year, or who shall have been engaged in the study and practice of engineering under a competent engineer for not less than two years. A Student shall not remain in that grade for more than seven years; if not elected to a higher grade his connection with the Society shall terminate at the end of seven years, or upon his attaining the age of 27 years.

The proposed Amendment of this Amendment is to strike out the last clause, in reference to Students, for reasons given above, and amend so as to read as follows:

Article XVII.—A member shall be a Civil Engineer, not less than 30 years of age who has been in active practice *in hydraulic, railroad, mechanical, mining electrical, topographical, hydrographical, sanitary or military engineering,* for at least ten years, or has graduated at a School of Engineering and been in practice *eight* years, and who has had responsible charge of work as Chief or Superintending Engineer for at least two years, not as a skillful workman merely, but as one qualified to design as well as to direct engineering works.

An Associate Member shall be one not less than 24 years of age, who has had actual practice in some of the branches of Civil Engineering for at least five years, or has graduated at a School of Engineering and been in practice *three* years and who continues in actual practice at the time of his application for membership.

The motive therefor is:

(1). The "Civil Engineer" includes all branches of Engineering work.

(2). The full period of study at a preparatory school should not be considered as equivalent to the same period of actual practice in the profession.

In the succeeding amendments, strike out all clauses relating to grade of *Student.*

The following Amendment will also be offered at the meeting, designed originally merely to improve the wording of the Amendments, and introduce some minor changes therein, but modified slightly since the appearance of the above circular to incorporate what is good in it, and exclude what is regarded as bad. These would have been sent out to members, and thus perhaps have brought out a less one-sided written discussion than the above circular is calculated to do, except that the late date at which it appeared made it impossible to send them out effectually before the Annual Meeting.

Amend Articles XVI and XVII to read as follows, amendments to the proposed amendments being *in italics:*

Article XVI.—The active membership of the Society shall be divided into three classes, to be styled respectively, Members, Associate Members and Associates; and each person, when duly elected and qualified, shall receive a certificate of Membership indicative of the class to which he belongs. *There shall also be a grade of Students.*

Members and Associate Members only shall have the right to vote, and Members only the right to vote on admissions to the Society and amendments to the Constitution and By-Laws. All persons connected with the Society shall have the right to receive the Society publications, to present papers and discussions thereon, to use the library and rooms of the Society, and to attend its meetings, subject to such regulations and restrictions as the Board of Direction may adopt.

Members of the Class previously styled Juniors, shall after March 7, 1888, be classed as Associate Members.

2.—Amend Article XVII of the Constitution by substituting for the present Article, the following:

Article XVII.—A member shall be a Civil, Military, Mining, Mechanical, *or Electrical* Engineer, not less than 30 years of age, who has been in active practice as such for at least ten years, or has graduated at a School of Engineering, and been in practice *eight* years, and who has had responsible charge of work as Chief, Resident, or Superintending Engineer for at least two years, not as a skillful workman merely, but as one qualified to design as well as to direct engineering works *of some considerable importance.*

An Associate Member shall be one not less than 24 years of age, who has had actual practice in some of the branches of Civil, Military, Mining or Mechanical Engineering for at least five years, or has graduated at a School of Engineering and been in practice *three* years, and who continues in actual practice, *with good professional standing,* at the time of his application for membership.

An Associate shall be one not less than 25 years of age, who is, etc., [same definition as now].

A Student shall be one not less than 18, nor more than 27 years of age, who is engaged in the study of Engineering with the intent to become an engineer, and who has pursued that study at a technical school not less than one year, or who shall have been engaged in the study and practice of engineering under a competent engineer for not less than two years. A Student *may remain as such for seven years, or until attaining the age of 27 years, when his connection with the Society shall cease unless elected to a higher grade.* [These amendments purely verbal.]

Amend Articles XVIII and XIX to read as follows, these amendments, except as *printed in italics,* being intended merely to give the same substance in much fewer words than the articles will contain if further amended as now proposed. As the Articles even now are the product of many successive amendments, some redundancy of words has naturally resulted.

Article XVII.—Applications for admission to any grade of the Society, whether by transfer or otherwise, shall contain a statement, over the candidates signature, of his age, residence, nature and term of his professional service, and that he will conform to the requirements of membership, if elected. Fellows shall not be required to present themselves as candidates: those making the nomination shall state the ground therefor, and certify that the nominee will accept if elected.

Applications for admission as Student must be endorsed by some one Member, Associate Member or Associate, and for admission to any other grade by at least five Members, who certify in each case that they personally know the candidate, and that he is worthy of acceptance. *Provided* that a candidate residing abroad *who certifies that he has obtained endorsements of his application from all Members personally known to him,* may be endorsed by Members of the Board of Direction without personal acquaintance, if they are

satisfied from the evidence that the candidate is a worthy one; AND PROVIDED ALSO, *that two of the endorsers of candidates for Associate Member may be member of the Board of Direction under similar conditions. But in each case the fact of such ex-officio endorsement shall be noted on the ballot list.*

In case of transfer from one grade to another the candidate shall be required to pay as entrance fee to the higher grade the difference between the entrance fees of the two classes.

Article XIX.—The election to the grade of Student shall be by unanimous vote of the Board of Direction. For all other grades the election shall be by letter-ballot, which shall be canvassed at the next regular meeting held after twenty-five days have elapsed from the time of mailing the ballot lists. Five or more negative votes shall exclude. In case of the non-election of any candidate no notice thereof shall be taken in the proceedings or minutes.

"The Board of Direction, upon receipt of letters from not less than eight members in good standing, requesting a reconsideration of the proposal of any rejected candidate, and stating the reasons for the request, may, if it considers the reasons to be sufficient, order another ballot to be taken; whereupon the Secretary shall mail to each member whose address is known, a notice of the same, with a letter ballot in such form as shall be prescribed by the Board of Direction, and requesting the recipient to vote thereby, or in person, on the day appointed by the Board to canvass the ballot, which shall be at a regular meeting held not less than 25 days after mailing of ballots. The ballot shall be an open one, and five or more votes cast in the negative shall exclude."

The following Motion will also be made at the Annual Meeting as to a modification in the present form of blank application for membership, the reasons for which are outlined on our editorial page.

Resolved, that the following changes be made in the present form of blank for Application for Membership, unless the Board of Direction see objections to the same, in which case they are requested to report their objections to the Society.

First, that the preamble to the application be amended to read "*I, A. B.*, residing at *N*, being desirous of admission into the American Society of Civil Engineers *in such grade as I may be found qualified for under the Constitution*," instead of "as Member" or other specific grade.

Secondly, that the concluding clause read "I will conform to the requirements of membership if elected, *and esteem myself qualified for the grade of* (blank.)

Thirdly, that the proposal by members be modified to read "On the grounds stated, and because we believe him from personal knowledge to be in all respects a proper person to be admitted into the American Society of Civil Engineers, we hereby recommend *A. B.*, of *N*, for election *to such grade as he may be found qualified for under the Constitution*," instead of for a specific grade.

Fourthly. That on receipt of an application an appropriate blank be sent by the Secretary to each proposer, to contain an inquiry as to what grade the proposers deem the candidate qualified for, and any other appropriate questions which the Board deem desirable.

ANNUAL MEETING, JAN. 18-19, 1888.

The programme for the Annual Meeting, Jan. 18 and 19, is thus announced:

Wednesday, Jan. 18.—The Meeting will open at 10 o'clock, and will continue through the day. Lunch will be served at the Society House at 13.30 o'clock.

During the Meeting the Annual Reports will be presented; Officers for the ensuing year elected; the awards of the Norman Medal and of the Rowland Prize for the past year announced; the place for the next Convention considered; Proposed Amendments to the Constitution discussed: Reports from various Committees presented and discussed; Technical Subjects discussed; General business transacted.

In the evening a paper on the Panama canal in 1887, by Lieut. C. C. ROGERS, U. S. N., will be read by the author and discussed.

Thursday, Jan. 19.—The arrangements for this day will be announced in detail at, or soon before the Meeting. They will include a visit to the bridge in progress of construction across the Harlem Valley (two steel arches of 510 ft. span each, and seven granite arches in approaches).

In the evening a reception for gentlemen will be held at the House of the Society, and at 21.30 o'clock supper will be served.

WILLIAM G. HAMILTON,
CHARLES W. HUNT,
JOHN EGGART, } *Committee.*

Illinois Society of Engineers and Surveyors.—The third annual meeting will be held in the State House at Springfield, Ill., commencing Wednesday evening, Jan. 25, and continuing Jan. 26 and 27. The final arrangement of the programme has not yet been made. Beside the reports of the standing committees the following papers will be presented, and others are partly promised:

President's address, Prof. I. O. BAKER. "Bridges and Viaducts for Cities." D. W. MEAD, City Engineer, Rockford. "Laying out Towns, and Monuments for Cities, &c.." Prof. T. C. MCCLANAHAN, Monmouth. "Highway Bridges," J. O. WRIGHT, Gilman. "Mine Surveying," F. V. ALKIRE, Petersburg. "Surveying, Practical and Artistic," D. L. BRAUCHER, Civil Engineer, Lincoln. "Culvert at Nichols' Hollow," E. A. HILL, Acting Chief Engineer I. D. & S. R. R., Indianapolis, Ind. "Specifications for Bridge Iron," Prof. I. O. BAKER, University of Illinois, "Mining Engineering Topic," A. C. BRAUCHER, Mining Engineer, Raton, New Mexico. "Bridge over the Ohio River, at Cairo," S. F. BALCOM, Assistant Engineer, I. C. R. R. Champaign. "Village Plats," Z. A. ENOS, Springfield. "Artesian Wells," Prof. T. B. COMSTOCK, University of Illinois. "Importance of replacing wooden trestles with iron and stone structures." J. M. HEALY, Division Engineer, I. C. R. R. Champaign. "Highway Bridges," P. E. LANE, Bridge Builder, Chicago. "Economic Efficiency of Tile Drains and Open Ditches," D. J. STANFORD, County Surveyor, Chatsworth.

The discussion and answer of questions in practice, usage, law, etc., has not heretofore received proper attention by the society, but as this is of especial value to the surveyors, it is hoped that every member will aid in this by sending in questions early enough to be referred to the proper committee.

There will be an exhibit and exchange of drawings and plans and an exhibit of instruments.

The hotels will give reduced rates. The headquarters will be at the Revere House where programmes can be obtained.

A. N. TALBOT, Executive Secretary, Champaign, Ill.

Canadian Society of Civil Engineers.—The last regular meeting was held on Dec. 29, with President T. C. KEEFER in the chair. The special object of the meeting was the discussion of Mr. BOSWELL'S paper on the "Quebec Harbor Works," presented at the previous meeting. This paper pointed out the faulty construction indulged in and charged the acknowledged failure to the fact that the works were designed and carried out by English engineers who were incompetent to deal with problems in which the Canadian climate played a part. The cost exceeded twice the original estimates. Among the mistakes pointed out were the following:—Carrying the works into the river instead of excavating towards the bank and an error in calculation whereby the size was reduced by 65 ft., removing 12 ft. of rock and filling the space with Portland Cement concrete so poorly made that it failed to stand Jan 8 ft. head of water, etc. The conclusion was that Canadian Engineering work had best hereafter be intrusted to Canadian Engineers.

Connecticut Association of Civil Engineers and Surveyors.—The annual meeting was held at Hartford, Conn., Jan. 10., and about 30 members were present. D. S. BRINSMADE, Secretary, read his report for the past year, in which he stated that the association comprises 89 members, 4 honorary, 5 contributing and 80 active. C. E. CHANDLER, President, in his address made the following remarks pertinent to the subject of contributions of papers, and his remarks apply outside the limits of the Connecticut association.

"Some seem to think that nothing they have done is worth mentioning, which is sometimes the result of modesty, but more often the result of an unwise pride which keeps them from writing anything unless it is something of very great importance. Some are too busy to write, but it is a well-known fact that busy people are generally best able to do something more, and the papers thus far furnished have not all come from the most idle members. The fact that an engineer is very busy is as a general thing the best evidence we can have first, that he has something to write about, and second, that his ability to systematize his work and thus economize time is such as to enable him to write it. I think if we all had the feeling when we run against and remove an engineering snag that would prompt us to take notes and say to ourselves: 'I must give an account of this to the association,' it would be the life of this organization. Half a dozen papers, 15 or 20 minutes long each, following by a prompt discussion and mingling of views, would be more entertaining and instructive generally, I think, than 2 or 3 long papers. Let us pool our every day experience for mutual help."

It was voted to change the name of "contributing" to "associate" members, but the proposition to reduce the annual dues of these members from $5 to $3 was voted down. In a discussion as to the relative merits of an annual meeting to last 2 days and 3 single day meetings as at present, the general opinion was in favor of the present method. JAY CARPENTER was elected as a contributing member.

The following officers were elected: President, C. H. BUNCE, Hartford; First Vice-President, F. F. WELD, Waterbury; Second Vice-President, WM. B. PALMER, Bridgeport: Secretary and Treasurer, D. S. BRINSMADE, Birmingham; Assistant Secretary, E. P AUGUR, Middletown. The following committees were elected.

Executive Committee—C. E. CHANDLER, of Norwich; B. H. HULL, of Bridgeport; E. P. AUGUR, of Middletown; C. M. JARVIS, of Berlin; C. H. BUNCE, of Hartford.

Membership Committee—T. H. MCKENZIE, of Southington; H. G. LOOMIS, of Hartford; W. B. PALMER, of Bridgeport.

Michigan Engineering Society.—The ninth annual meeting will be held in Kalamazoo on Jan. 17, 18, 19 and 20. The programme is as follows:

Jan. 17, 2 P. M.: reports of officers and committees; admission of members to the new society; "Stray Thoughts of an Engineer in Cross Section and Profile," by WM. APPLETON, City Engineer, Lansing.—7 P. M.: address by the president, GEO. E. STEELE, of Traverse City; "Heating Residences with Hot Water," by Prof. R. C. CARPENTER, Agricultural College, Lansing; paper by Prof. M. E. COOLEY, Univ. of Michigan, Ann Arbor. —Jan. 18, 9 A. M.; appointment of committees; "Village Plats," by Prof. R. C. CARPENTER and J. E. SHERMAN of Marquette; "Map Drawing," by Prof. C. S. DENISON, Univ. of Mich., Ann Arbor; jottings, questions, etc.—2 P. M. "History of Portage Lake and Lake Superior Canal," by J. H. FORSTER, Williamston: "Improvement of the Middle Neebish Channel," by JOS. RIPLEY, U. S. Eng., Sault Ste. Marie; "Plane Table Surveying," by Prof. J. B. DAVIS, Univ. of Mich., Ann Arbor. In the evening there will be a supper and social at the American House.

Jan. 19, 9 A. M.: "What a Special Agent saw in Oregon and Nebraska," by U. S. Dep. Surveyor, I. TELLER, Cohoctah; "Surveying in Florida," by S. C. HODGMAN, C. E., Haines City, Fla.: "The Invention of the Solar Compass," by J. H. MULLETT, Williamston; "Reminiscences of John Mullette," by J. H. FORSTER, Williamston.—2 P. M.: "Combination Bids," Prof. J. B. DAVIS, Ann Arbor; "Economic Location & Construction of Railways," E. BARRINGTON, Chf. Eng. Pacific R. R., Superior, Neb.; "Some Difficult Railway Foundations," O. C. GILLETTE, Traverse City; "Michigan Railroads in 1887," A. L. REED, Chf. Eng., Pt. Huron & Northwestern R. R., Port Huron.—7 P. M.: "Sources of Error in the Gradienter," H. C. PEARSONS, Ferrysburg; remarks of instrument makers; "Underground Channels of Water," W. R. COATS, Kalamazoo; reports of committees.—Jan. 20; visits to points of interest.—F. HODGMAN, Secretary and Treasurer, Climax, Mich.

The American Institute of Mining Engineers will hold its annual meeting at Boston, Feb. 21 to 25, 1888, the sessions to be held at the Institute of Technology. The local committee having the meetings in charge comprise A. S. BIGELOW, Chairman, and C. J. H. WOODBURY, CHARLES O. PARSONS and W. E. C. EUSTIS.

CONSTRUCTION NEWS.

Water.

Water-Works.—*Maine.*—Waterville. The waterworks were tested Jan. 2. With the reservoir half full, five streams were thrown higher than the tallest building.—Old Orchard. A preliminary test was made Jan. 3.—Seal Harbor. The Seal Harbor Water Co., capital stock $10,000, is taking subscriptions. It is intended to bring water from Jordan's pond, 2 miles distant, by a 6-in. main and distribute it through smaller pipes. The pipe may be laid by next season.

New Hampshire.—Dover. On Jan. 6, the City Council appointed a committee to negotiate with the 3 aqueduct companies, with a view to purchasing their interests and establishing public water-works in accordance with the recent vote of the citizens.

Massachusetts.—Brookfield. The pipe laying is almost completed: there will be 10,476 ft. of 6 to 12-in. pipe and 9 hydrants. The water will be taken from a reservoir.

Rhode Island.—Westerly. The Westerly Water-Works have purchased the system of the Westerly Water Co. which consists of a covered reservoir supplying 2 miles of 2 and 3-in. pipe on streets in which are also located the mains of the Shunoc system. About 30 buildings are supplied by the smaller system, which will be operated as formerly.—Pawtucket. Work is in progress on the new pumping station at Valley Falls. There will be a filter gallery 100 by 20 ft., supplied with water from a 36-in. conduit from Happy Hollow dam. There will be a 6,000,000 galls. compound Corliss engine, and 2 more pumps of similar capacity can be added when necessary.

New York.—At Coxsackie and Alfred Center waterworks are contemplated.

Pennsylvania.—Rochester. The new water company will issue $200,000 in stock, and is negotiating for a site for the works. The supply will be available by September.—Reading. The question of increasing the city debt by $300,000 for a new water supply will be put to the public vote.—Lebanon. A report on water supply has been made by A. HARVEY TYSON, of Reading, recommending that the supply be taken from Swatara creek at Jonestown, and that a pumping station, standpipe, etc., be erected; estimated cost, $200,000. The Water Committee has adopted the report: a proposition was made by Arthur and Horace Brock to build the works and lease them to the city at a rental of 5 per cent. on the cost.

Virginia.—Warrenton. A proposition to establish

water-works and an electric light plant has been made by New York parties. Address the mayor.—Portsmouth. The Portsmouth & Suffolk Water Co. is reported as trying to purchase the old battery property on the line of the Seaboard road for use for a reservoir.——Marion. Water-works are wanted. Proposals will be received by J. H. FRANCIS, Town Recorder.

Georgia.—Americus. Address the mayor with regard to projected water-works.

North Carolina.—Greensboro. A water company has been incorporated with a capital stock of $75,000 and will begin work soon. THOMAS B. KEOGH, President: FRED B. HUBBELL, Secretary and Treasurer.

Michigan.—Greenville. The artesian wells have struck water.——Springwells. The village wants to be annexed to Detroit in order to be supplied from the city water-works.

Illinois.—Joliet. Proposals for the construction of water-works will be received by the Mayor, JOHN D. PAIGE, till Feb. 1.

Missouri.—Washington. The question of establishing water-works and the electric light will be put to the public vote. The necessity of water-works has long been felt but the taxpayers in the suburbs have opposed the project.

Kansas.—Douglass. The Douglass Water-Works Co. has been incorporated by S. H. BRANDON, J. C. ELLIOTT and others. Capital stock, $50,000.——Ellsworth. The water-works built by A. L. DRAPER, of Ellsworth, were tested Dec. 30 with satisfactory results. Four 1-in. streams were thrown to a height of 100 ft.——Great Bend. The water-works have been completed but not yet accepted by the city.

Nebraska.—Weeping Water. At the vote on the issue of $15,000 in bonds for water-works only one opposing vote was cast. Work will be commenced early in the spring. Bonds were issued several years ago but owing to a technicality discovered by the opponents they were never issued. The recent serious fire stirred the people to action.——Beatrice. It is reported that an additional supply will be needed at a very early date.

Texas.—Waco. The city council will consider the question of a water supply, as the contract with the Waco Water Co. terminates in July.

Jersey City, N. J.—Since the large duplex pump at the reservoir broke recently, the Hackensack Water Co. has been supplying water to the Heights portion of the city. The company has made a proposition to the city authorities to continue the supply at the rate of $100 per million gallons, and the Board of Public Works has accepted the proposition. The company will continue to supply the water only until a new pump is purchased by the city. The Board has ordered advertisements for bids for the construction of a pump with a capacity of 5,000,000 gallons.

Proposals Open.

Water Works.—Complete system. J. H. FRANCIS, Town Recorder, Marion, Va.

Pumping Engine.—Capacity 5,000,000 galls. THE BOARD OF PUBLIC WORKS, Jersey City, N. J.

Railroad.—Grading near Sallyville, S. C. GEO. A. WAGENER, President, Blackville, Alston & Newberry R. R. Co., Charleston, S. C.

Electric Light Plant.—M. L. FUNKHOUSER, Hagerstown, Md.

Special Castings.—About 200 tons. ANDREW RINKER, City Engineer, Minneapolis, Minn.

River Improvement and Levee.—Straightening the channel of the Rio Grande and building levee at Alamosa. ALVA ADAMS, Chairman, Board of Construction, Denver, Col. Jan. 16.

Iron Bridge.—Span, 100 ft.; 12 ft. wide. A. H. KOEBNER, County Commissioner, County Auditor's office, Huntingburg, Ind. Jan. 18.

Submerged Pipe.—For outfall sewer; about 1,000 ft. of 16-in. pipe; greatest depth of water 50 ft. WILLIS CHIPMAN, Engineer, Brockville, Ont., Canada. Jan. 18.

Street Work.—THOS. G. SMITH, President, Board of Public Affairs, Cincinnati, O. Jan. 19.

Water-Works Supplies.—Pumping engine, boilers, cast-iron pipe, hydrants, etc. GEO. W. PHELPS, Mount Morris, N. Y. Jan. 20.

Steel Rails, Etc.—Side bearing rail, 35 lbs. per yd., 70 tons; frogs and switches, curves and crossings; 440 joint plates, ½ × 4 × 18 ins.; 5,500 single and 900 double knees; 6,000 lbs. spikes. FRED J. H. RICKON, Engineer, City Electric Ry. Co., Little Rock, Ark. Jan. 21.

Cast-Iron Water Pipe.—Tons of 2,000 lbs.; 100 tons of 12-in., 48 tons of 10-in., 77 tons of 8-in., 112 tons of 6-in. and 10 tons of 4-in. Special castings, 19,000 lbs. Proposals for the whole, or for castings alone, or for any one size of pipe. Plans and specifications with the Water Department. THOMAS J. NEVILLE, Clerk, Executive Board, Rochester, N. Y. Jan. 27.

Pumping Engine.—Capacity, 5,000,000 or 7,500,000 galls. THE WATER-WORKS TRUSTEES, Sandusky, O. Jan. 31.

Water-Works.—Complete system; 12,100 ft. of 4, 6, and 8-in. pipe; 25 hydrants, valves, etc.; pumping engine with daily capacity of 1,000,000 galls.; filter gallery, buildings, etc. LOWETH & CURTIS, Drake Block, St. Paul, Minn., are the Engineers. J. H. JEFFERS, Chairman, Water-Works Committee, Cedar Falls, Ia. Jan. 31.

Machine Tools.—Time extended to Feb. 2. HON. WM. C. WHITNEY, Secretary of the Navy, Navy Department, Washington, D. C. Feb. 2.

Bridges.—Two bridges across the Neuse river in Wake county. JESSE WINBURN, County Commissioners' Bridge Committee, Raleigh, N. C. Feb. 6.

Street Lighting.—Gas, coal oil or other material. WILLIAM RIDDLE, Chairman, Lamp Committee, Mayor's office, Lancaster, Pa. Feb. 17.

Pumping Engine.—Capacity, 700,000 galls. THE LEAVENWORTH WATER CO., Leavenworth, Kan. Feb. 20.

Contracting.

Road Work.—At Birmingham, Ala., the contract for improving the county roads has been awarded to M. G. Kennedy, at $38,927.70.

Proposals for Pumping Engine.—At Leavenworth Kan., the water company has rejected all bids for the 700,000 galls. pump as too high. Proposals will be received till Feb. 20.

Pumping Engines.—The Water-Works Trustees, Columbus, O., have awarded the contract for a vertical, compound, condensing engine, with a daily capacity of 15,000,000 galls., to the Holly Manufacturing Co. of Lockport, N. Y., for $73,500, the company to give $3,000 for the old engine. The proposals were given on p. 446 of the last volume.

McMahon, Porter & Co., of New Cumberland, W. Va., manufacturers of salt glazed pipe for sewers and culverts, and of other stoneware and fire clay goods, drain tile, firebrick, etc., have issued a new illustrated catalogue and price list. It contains directions for laying pipe, tables of capacities, etc.

Bridge.—The contract for rebuilding the Fort Argyle bridge over the Savannah and Ojeechee canal, 14 miles from Savannah, Ga., and for keeping the same in repair for 7 years, has been awarded to Chesley Dugger, for $250.

Harbor Improvement.—The following proposals for material for the improvement of Vicksburg harbor, were received Dec. 29 by Capt. WM. T. ROSSELL, U. S. Engineer Office, Memphis, Tenn.:

BIDDERS.	2,000 cords willow brush. Per cord.	1,000 cypress piles. Per ft.	2,000 cu. yds. rip-rap stone. Per cu. yd	240 Str'g'rs		350 Braces.	
				Willow. Each.	Cypress. Each.	Willow. Each.	Cypress. Each.
	$	cts.	$	cts	$	cts.	cts.
M. V. McBride, Greenville, Miss.	1.45	6½	....	85	1.05	40	50*
J. McBride & Evins, Greenville, Miss.	1.30	6½	....	80	1.00	37½	45
Karr & Neil, Van Buren, Mo.	1.45	6½	....	90	.90	50	50*
N. L. Killebrew, Memphis, Tenn.	1.75	9½	....	1.30	1.30	60	60
Elisha Evins, Memphis, Tenn.	1.09	12½	1.39	....	4.50	$1.50	$1.50
	1.27½	....	....	87½		40	.....

*Delivered at Vicksburg.

Water Pipe.—The following proposals were received by ROBT. K. MARTIN, Chief Engineer of the Water Department, Baltimore, Md., from (*A*) the McNeal Pipe & Foundry Co., Burlington, N. J.; (*B*) R. D. Wood & Co., Philadelphia; (*C*) Gloucester Iron Works, Gloucester, N. J.; (*D*) Mellert Foundry & Machine Co., Reading, Pa.:

	A	*B*	*C*	*D*
	cts.	cts.	cts.	cts.
1¼-in. pipe; per ft.	9	10½	11½	no bid
2-in. " "	16	15½	18	"
3 in. " "	20	19½	23	"
4-in. " "	30	29	33	32
6 in. " "	44	43	45	45
8-in. " "	60	59	63	63
10-in. " "	80	78	83	81
12-in. " "	$1.15	$1.17	$1.20	$1.20
20-in. " per ton of 2,240 lbs.	$29.45	$30.73	$30.59	$31.36

Railroad Contracts.—*Minnesota & Dakota R. R.*—The contract for grading a single track from Fargo, Dak., 152 miles northwest to a point 15 miles west of New Rockford, Wells county, Dak., has been awarded to Job. Voak.

Charleston, Cincinnati & Columbus R. R.—P. P. Dickinson and Samuel Dunavant have contracts on this road.

Nashville & Knoxville R. R.—J. C. Rodemer, of Gallatin, Tenn., has the contract for 22 miles of road between Cookeville and Paving Fork.

Knoxville Southern R. R.—R. Jones, Tenn., has the contract for the construction of 4 sections of this Tennessee road.

Carolina, Knoxville & Western R. R.—The contract for building 160 miles between Knoxville, Tenn. and Greenville, S. C., has been awarded to the Georgia Construction Co., of Augusta, Ga., and work will be commenced this month. The road is to be in operation between Knoxville and Augusta, by July.

Nashville & Tellico R. R.—McDonald, Shea & Co. of Knoxville, Tenn., have the contract for grading 20 miles of the road, from a point 5 miles from Athens, Tenn., to Tellico Plains, Monroe county; also for cross ties, tracklaying, bridging and masonry from Athens to Tellico.

Steam Heating.—The following proposals for steam heating at the new jail have been received by the Police Commissioners, St. Paul, Minn.: E. T. Sykes & Co., $1,310; F. F. Martin, $1,344; Haxtun Steam Heating Co., $1,590; Porter Steam Heating Co., $1,650. The contract was awarded to E. T. Sykes & Co.

Water Tower, Tank, Boilers, Pump, Etc.—The Commissioners of Public Charities and Correction, New York City, have awarded contracts as follows for the work at Central Islip, L. I.: water tower and tank, residence and boiler house, James H. Brady, $5,986; 2 steam boilers, Alexander Reid, $1,650. All the bids for the duplex pump were rejected.

Street Grading.—The following proposals for grading on Commonwealth avenue have been received by WM. MCDONALD, Superintendent of Streets, Boston, Mass.: P. O'Riorden, $1.19 per cu. yd.; Neil McBride, $1.37; Hugh Nawn, $1.60; Moulton & O'Mahoney, $1.65.

Iron Pipe.—The following proposals for furnishing 12-in. iron pipe for the 8th lighthouse district were opened Dec. 30, by Capt. W. L. FISK, Lighthouse Engineer, New Orleans, La.: Jas. H. Aitken & Co., New Orleans, $40 per ton; Woodward, Wight & Co., New Orleans, $44.

Court House.—The following proposals have been received by the County Commissioners, Lincoln, Neb., for the new court house: R. K. Allen, St. Joseph, Mo., $260,000; Fitzgerald & Brenan, Omaha, Neb., $296,076; W. H. B. Stout, Lincoln, Neb., $303,336; O. J. King & Co., Omaha, Neb., $329,411. All the bids were in excess of the appropriation.

Steam Heating.—Cornell University, at Ithaca, N. Y., has about 3,000,000 cu. ft. of buildings to be heated now, and double that amount when the buildings now projected are finished. The Trustees are considering plans for heating from a central station, presented by the Lockport Co., and others. It is expected the work will be the best and most economical of its kind constructed up to the present time.

Water Pipe.—The following proposals for 83,051 ft. of 6 to 24-in. cast-iron pipe were opened Jan. 3, by the Water-Works Committee, Minneapolis, Minn.: Dennis Long & Co., Louisville, Ky., $29.97 per ton; Lake Shore Foundry, Cleveland, O., $30.14; Shickle, Harrison & Howard, St. Louis, Mo., $31.10; Addyston Pipe & Steel Co., Cincinnati, O., $31.40; Mellert Foundry & Machine Co., Reading, Pa., $35. The contract was awarded to Dennis Long & Co. The city engineer was instructed to advertise for 200 tons of specials, the bidding being confined to local firms.

Pumping Engines.—The Water-Works Trustees, Sandusky, O., will receive bids until Jan. 31, for a pumping engine of 5,000,000 or 7,500,000 galls. daily capacity; to include sandstone foundations and the necessary steam and water connections. Bidders to submit drawings and descriptions, together with a guarantee of duty and capacity. General specifications may be obtained. Bids will also be received at the same time for the purchase and removal of a pumping engine, now in use, of about 2,000,000 galls. daily capacity.

Pipe and Specials.—The following proposals have been received by the Water Commissioners, Albany, N. Y.: M. J. Drummond, New York City, 6-in. $31.70; 12-in., $31.50 per ton of 2,240 lbs.; Gloucester Iron Works, Philadelphia, Pa., $32.39 and $31.63 per ton, specials $57.33 per ton; R. D. Wood & Co., $32.75, $31.75 per ton, specials 2¾ cts. per lb.; McNeal Pipe & Foundry Co., Burlington, N. J., $32.75, $31.75 per ton; Warren Foundry & Machine Co., Phillipsburgh, N. J., $32.90 per ton for 6 and 12-in.; Mellert Foundry & Machine Co., Reading, Pa., $33.50, $3, specials 2¾ cts. per lb.

Gas and Electric Light.—The following proposals for furnishing gas or other illuminating material for street lamps and public buildings for 1888 were received by the Commissioner of City Works, Brooklyn, N. Y.: People's Gas Light Co., $22 per lamp per year; public buildings, $1.60 per 1,000 cu. ft., Nassau Gas Light Co., $22 and $1.60 respectively. Metropolitan Gas Light Co., $22 and $1.60. Williamsburg Gas Light Co., $21.75 and $1.60. Citizens' Gas Light Co., $22 and $1.60. Brooklyn Gas Light Co., $19.80 and $1.50. Citizens' Electric Illuminating Co., $182.50 per light per year. Municipal Electric Light Co., $182.50 per light per year.

Steam Pile Hammer.—The Vulcan Iron Works, Chicago, Ill., are introducing the Nasmyth steam hammer for pile driving. A. S. Hayne, contractor, of Quanah, Tex., has used one of these machines for driving 500 piles, 44 ft. long, to depth of 28 ft., across the Canadian river, Texas, for the Panhandle Construction Co. Not one pile was split or shattered by driving, while the hammer was running at the rate of 85 blows per minute. T. E. Bissel, of Quanah, Tex., Chief Engineer of the Panhandle Construction Co., was particularly pleased with the machine as it put down the piles without splitting, enabling them to be driven within a few inches of grade line. The machine was run with a 18 H. P. boiler, and its performance was in every way satisfactory.

Pipe, Hydrants, Etc.—The following proposals were received by the Board of Water Commissioners, St. Paul, Minn.: 5,000 tons of cast-iron pipe and specials; Shickle, Harrison & Howard Iron Co., St. Louis, Mo., $153,673.20; Dennis Long & Co., Louisville, Ky., $158,390.80; Lake Shore Foundry, Cleveland, O., $159,719.90; R. D Wood & Co., Philadelphia, Pa., $163,063.62; Addyston Pipe & Steel Co., Newport, Ky., $163,076; McNeal Pipe & Foundry Co., Burlington, N. J., $181,132.97. The contract was awarded to the Shickle, Harrison & Howard Iron Co.

Valves: Galvin Brass & Iron Works, Detroit, Mich., $5,234.50; Eddy Valve Co., Waterford, N. Y., $5,820.50; Coffin Valve Co., Boston Mass., $5,905; R. D. Wood & Co., Philadelphia, Pa., $6,545.56; Whittier Machine Co., Boston, Mass., $8,121.75. The contract was not awarded.

Pumping Engines.—The following proposals for pumping engines for the new water-works at Pontiac, Mich., were received Dec. 21, 1887, by J. D. Cook, C. E., of Toledo, O.: Two compound, condensing, duplex engines, daily capacity, 1,500,000 galls. each, with 2 boilers: Deane Steam Pump Co., Holyoke, Mass.; plunger pumps, $7,372, $8,492 and $13,067 (the first price for 1 engine and 1 boiler, the second price for 1 engine and 2 boilers). Geo. F. Blake Mfg. Co., New York, $15,000. Knowles Steam Pump Co., New York; plunger pumps, $12,000. Holly Manufacturing Co., Lockport, N. Y.; plunger pumps, $16,000, $19,000; direct acting, $8,300. Volker & Felthousen, Buffalo, N. Y.; piston pumps.

Two compound, condensing, duplex engines, daily capacity 1,000,000 galls. each, with 2 boilers: Geo. F. Blake Mfg. Co., New York, plunger pump, duty 50,000,000; $10,047.50. Knowles Steam Pump Co., New York; plunger pump, $9,800; non-condensing, $7,365. Holly Manufacturing Co., Lockport, N. Y.; plunger, crank and flywheel, $16,000; direct acting, $6,800. Volker & Felthousen, of Buffalo, also bid.

High pressure engine, daily capacity 1,000,000 galls. Deane Steam Pump Co., Holyoke, Mass.; $840 and $950 for 1 pump. Geo. F. Blake Manufacturing Co., New York, $1,812 for 1 pump. Volker & Felthousen, of Buffalo, $1,028 for 1 piston pump. Knowles Steam Pump Co., New York, $8,175 and $9,175 for 2 pumps.

Pontiac, Mich., Water Works.—The following were the proposals received for the new water-works at Pontiac, Mich.; J. D. Cook, of Toledo, O., Consulting Engineer.

Pipes and Special Castings.—Detroit Pipe & Foundry Co., Detroit, Mich.: 4, 6, 8, 10, 12, 14, 16 (heavy), and 16 in. (light) pipe, $29.15 per ton, all sizes; specials, $49 per ton. Warren Foundry & Machine Co., New York: $34.50, $34.50, $34, $34, $33.25, $33.25, $33, $33; specials, 2¼ cts. per lb. Collins & Humphrey, Pittsburg, Pa.: $33 per ton, all sizes; 3¼ cts. Shickle, Harrison & Howard Iron & Pipe Co., St. Louis, Mo.: $32.50 all sizes, $73 per ton. Dennis Long & Co., Louisville, Ky.: $12.47 all sizes, 3¼ cts. per lb. Mellert Foundry & Machine Co., Reading, Pa.: $36, $34, $34, $33, $33, $33, $33, $33; $35 per ton. Buffalo Cast Iron Pipe Co., Buffalo, N. Y.; $32 all sizes; 3 cts. per lb. Addyston Pipe & Steel Co., Newport, Ky.: $29.40 all sizes; $49.90 per ton. R. D. Wood & Co., Philadelphia, Pa., $32 all sizes; $60 per ton. New Philadelphia Pipe Works, New Philadelphia, O.: $27.50 all sizes except $27.57 for 16-in. light; $50 per ton. Lake Shore Foundry, Cleveland, O., $28.25 all sizes; $50 per ton. Ohio Pipe Co., Columbus, O., $27.50 all sizes; $50 per ton.

Pipe Laying.—Snyder & Williams, Dayton, O.: 4, 6, 8, 10, 12, 14, 16 (heavy) and 16-in. (light); 15, 17½, 26, 30, 31, 36, 40 cts. and $1.20 per ft.; valve boxes, $3 each. Aggregate $45,789, including hydrants and valves; pipe at $27.43; specials at 2½ cts. Adam Miller, Saratoga, N. Y.: 17, 25, 28, 34, 40, 45, 52 and 90 cts. per ft.; $3.75 each. H. Merrigold & Co., Lima, O., 15¾, 16, 21¾, 30¼, 30¾, 40, 40, and 40 cts. per ft.; $3 each. A. B. Carrothers & Co., 20, 23, 27, 31, 35, 40, 42 and 75 cts. M. Philbin, Grand Crossing, Ill., 15, 17, 22, 24, 26, 34, 36 cts. and $1. Dennison & Cowell, 18, 24, 26, 28, 31, 35, 37 cts. and $1.50; $52,000 including valves and hydrants, furnishing and laying. A. W. Morgan: valve boxes, $2.95 each. Richard Dixon; 27, 23, 35, 38, 38, 40, 45 cts., no bid; valve boxes, $3.90.

Valves and Hydrants.—The bidders were as follows: Frontier Iron & Brass Works, Detroit, Mich.; National Tube Works, Chicago, Ill.; Chapman Valve Mfg. Co., Indian Orchard, Mass.; James Flower & Bros., Detroit; Galvin Brass & Iron Works, Detroit; W. S. Payne & Co., Fostoria, O.; Eddy Valve Co., Waterford, N. Y.; R. D. Wood & Co., Philadelphia; Whittier Machine Co., South Boston, Mass.; Bourbon Copper & Brass Works, Cincinnati, O.; Holly Manufacturing Co., Lockport, N. Y.

Stand Pipe.—Lansing Iron Works, Lansing, Mich.: $13,500 without foundations; Stacey Mfg. Co., $14,227 without foundations. L. B. Stevens, $11,780 for foundations only; Daniel Scott, $11,730 for foundations only.

Building and Chimney.—L. B. Stevens, $7,955. Daniel Scott, $498.55 for foundation stone work only.

Supply Well.—L. B. Stevens, $2,450.

Works Complete.—Dennison & Cowell, $63 500; including building, chimney, well, pipe and pipe laying, special castings, valves and hydrants. W. S. Parker, $81,462; including everything complete; deduct $15,000 if stand-pipe is not built.

Pumping Engines.—(These bids are given separately in the preceding column).

RAILROADS

East of Chicago.

Existing Roads.

Grand Trunk.—The report that the company is to obtain control of the Northern & Northwestern system causes renewed conjectures regarding the Sault Ste. Marie extension. But it would seem the part of wisdom at least for the company to wait and see if the Canadian Pacific line to the Sault proves a profitable enterprise before it concludes to parallel its competitor. Especially as the line must traverse a country so barren that no amount of local traffic can be secured, must extend over a distance so great that an enormous capital will be required; and all to secure a through traffic to the seaboard, already contended for by a great number of old and wealthy roads, able to either keep up a ruinous competition, or secure a lion's share in any pooling arrangement which may be made.——The proposed extension from Montreal to Ottawa *via* St. Eustache, St. Andrews and Carillon will probably be surveyed at an early day. The people along the proposed route are willing to extend aid to the enterprise, and they urge its early prosecution.

Evansville & Terre Haute.—The purchase of the Indianapolis, Decatur & Western by President MACKEY adds 152.5 miles to this system and makes its total extent 321.5 miles.

New York, Pennsylvania & Ohio.—H. C. THOMPSON, General Road Master, has been appointed Engineer-in-Charge of the double tracking on the Mahoning division. He has a force of 22 men at work on the surveys and estimates for the work, and expects to have them ready to submit to contractors by Feb. 1. Work will begin as early in the spring as weather will permit.

New York Central & Hudson River.—It is stated that this company will co-operate with the Rome, Watertown & Ogdensburgh in erecting a large union depot at Syracuse, N. Y.

New York, Ontario & Western.—The earnings of this company for 1887 were increased $315,000 over the amount in 1886.

New York, New Haven & Hartford.—It is proposed to extend the branch of the Northampton division which now runs to New Hartford on to Lee, Mass.

Central Railroad of New Jersey.—The managers of both the financial and operating departments of this company are to be congratulated on the termination of its receivership and on the prospects which are now before the company. If it was able to earn 8 per cent. while in the receiver's hands, it should be able to make a phenomenal record now that it is under control of its owners.

Pennsylvania.—Surveys are in progress for a branch to run from Latrobe, Pa., to Trauger Station, the terminus of the Sewickley branch. Rumored extensions in the West are from St. Francisville to Evansville, Ind., and from Hamilton, O., to Richmond, Ind.

Toledo, Ann Arbor & North Michigan.—The completion of the new line from Mt. Pleasant to Cadillac, 68 miles, was celebrated by an excursion over the line of prominent railroad and business men of Michigan. An accident on the road caused a delay, which was supplemented by a snow storm so heavy that four engines were required to haul the excursion train through the drifts, and the train arrived at Cadillac 19 hours late. The grand banquet which had been prepared was duly eaten and a second and plainer one was served on the arrival of the crowd of hungry excursionists who had been out all night in the snow drifts of the Michigan forests.

New York Mahoning & Western.—Mr. JOHN K. BRICE, Chief Engineer, writes us from Lima, O., that grading is completed from Findlay to Ottawa, O., 20.2 miles, the line running south of Blanchard river. The final location of the line east and west of these points is not yet definitely decided upon. Mr. E. B CHAPMAN, 26 Broad St., New York, is President of the company and C. N. HASKELL of Ottawa, O., is Vice President.

New Projects and Surveys.

New York & Boston Rapid Transit.—Although the information regarding this company given in our issue of Nov. 26, was taken from the printed report sent to us from the company's Boston office, it seems that the line is not yet ready for letting contracts, as was then stated. General Manager D. C. LINSLEY informs us that there is yet considerable office work to do before the line will be ready for contractors' estimates. The line from Harlem river to the corner of 59th street and 8th avenue in New York City, will follow the route already described, and will be a masonry viaduct running through the blocks, for which the right of way is all secured. The negotiations for terminals in Boston are still in progress. A meeting of the stockholders is to be held in February, when a successor to President BODWELL will be chosen, and arrangements made for actively prosecuting work.

Sandusky, Ashland & Coshocton.—At a stockholders' meeting Jan. 4, JOHN MACKEY of Sandusky, O., was elected President, and P. H. CLARK of Ashland, Secretary.

Rome & Sylvan Beach.—

ONEIDA, N. Y., Jan. 9, 1888.

EDITOR ENGINEERING NEWS:

The Rome & Sylvan Beach R. R. is to be about 13 miles in length. Surveys were begun December 20, and right of way is being secured. Bonds of the company are being negotiated and it is expected to let contracts in March and have the line ready for business by June 20, in time for the summer travel from Rome to Sylvan Beach, which is a local resort of growing importance.

WALTER F. RANDALL, *Chief Engineer.*

Buffalo, Chippewa & Niagara Falls Steamboat and Railway Co.—Application is to be made to the Dominion Parliament for a charter for this company, which proposes a steamboat line from Buffalo to Chippewa upon the Niagara River, and a railroad line from Chippewa to Niagara Falls village, to be operated by steam, electricity, or horses.

SOUTHERN.

Existing Roads.

Cincinnati & Southeastern.—This company's line was originally projected from Newport, Ky., to Pound Gap, Ky., 250 miles; but only 18½ miles, from Johnson to Hillsboro, was ever completed. The company has just concluded to abandon its line from Flemingsburgh to Hillsboro, 11 miles, as it has never paid expenses. CHAS. MILLER of Franklin, Pa. is President.

Central R. R. of Georgia.—It is announced that this company has absorbed the Savannah, Dublin & Western Short Line, and will complete it at once from Savannah to Perry or Fort Valley. The officers of the company are discussing the proposed union depot at Atlanta, and one costing a quarter of a million dollars or more will probably be built at an early day.

Athens & Tellico.—McDonald, Shea & Co. have the contract for 20 miles of this Tennessee road.

Blackville, Alston & Newberry.—Contracts are to be let soon for grading on the extension of this road.

Memphis & Charleston.—The surveyors are again at work on the extension from Stevenson, Ala.

Buena Vista & Ellaville.—President ALEXANDER, of the Central Railroad of Georgia, is reported to have stated that the extension of this line to Columbus will be built in time for fall trade.

Carolina, Knoxville & Western.—The company has now received $600,000 in county subscriptions, and grading is about finished from Augusta, Ga., to Greenville, S. C. Contracts for building the road have been let to the Georgia Construction Co, of Augusta.

Kingwood & Tunnelton.—This 10-mile road in Preston county, W. Va., is about completed. It is proposed to extend it the coming season to Fairchance. GEO. M. WHITESCARVER, Grafton, W. Va., is Superintendent.

New Projects and Surveys.

Atlantic, Atlanta & Great Western.

ATLANTA, Ga. Jan. 3, 1888.

EDITOR ENGINEERING NEWS:

Enclosed find a copy of my report to the board of directors. The capital to build the road except as to $2,000 per mile is already secured. This $2,000 per mile is being rapidly taken by the citizens along the line. Putnam county last week subscribed $100,000. Hancock county will take action January 10; her leading citizens assure me that this county will subscribe $100,000. I am assured that Burk county will also subscribe $125,000 and the balance will be easily obtained in Atlanta and Savannah. These subscriptions are not by county authority but are individual and are gilt edge. GEO. T. FRY, *President.*

The following is taken from President FRY'S report:

The following is substantially a correct estimate of the length of the Atlantic, Atlanta & Great W stern Railroad, from Atlanta to Savannah, Georgia, the cost of construction and equipment, and the probable earnings of said road when completed between said cities. This data is all furnished by experts in railroad building and management. The distance from Atlanta to Eatonton is 65 miles; from Eatonton to Sparta 27½ miles; from Sparta to Waynesboro 57½ miles; from Waynesboro to Savannah 85 miles; making altogether 235 miles. Allowing for all necessary deflections on account of grades and swamps, and to reach eligible crossings of water courses, 250 miles will cover the entire distance between Atlanta and Savannah, which is 43 miles shorter than the distance between the two

points by the Central Railroad, 47 miles shorter than by the East Tenn., Va. & Ga. Railroad, and 61 miles shorter than the Georgia Railroad route *via* Augusta. To grade this road, lay the track with steel rails of the full standard of 56 lbs. to the yard, or eighty-eight tons to the mile, and to furnish it with first class equipment, will cost about the following:

22,000 tons steel rails at mill @ $33 per ton	$ 726,000
1,760,000 lbs. fish bars, 2 cents per lb. at mill	35,200
382,000 lbs. bolts, 3½ cents per lb. at mill	12,320
7,000 kegs of spikes, 5½ x 9-16, 200 lbs. per keg, $5.20 per keg at mill	36,400
666,000 cross ties, to be laid 2 ft. from center to center, 25 cents each	166,400
250 miles of grading with necessary culvert-, water-ways and stock-gaps, average cost $4,000 per mile	1,000,000
4 iron bridges across Yellow, Alcovey, Oconee and Ogechee rivers, average cost of each $25,000	100,000
250 miles track-laying, leveling up, etc., including ballast where needed, $400 per mile	100,000
Terminal facilities at Atlanta and Savannah	200,000
30 depots, with necessary side tracks and wood and water stations, average $2,500 each	75,000
500 freight cars, $460 each	230,000
50 passenger, express and mail coaches at $2,000 each	100,000
40 locomotive engines, $10,000 each	400,000
	$3,181,320
Freight on material, engineering and all other contingent and incidental expenses, add 10 per cent. on the above	318,132
Total	$3,499,452

This estimate is based upon a first-class road-bed, first-class rails and iron bridges and an equipment never surpassed and seldom equalled by any new road. This road connecting at Atlanta with the Western & Atlantic and the Marietta & North Georgia, the Western & Atlantic connecting at Chattanooga with the Cincinnati Southern; the Marietta & North Georgia extending to Knoxville, Tennessee, and with this road's line extended to Sheffield, Alabama, on the Tennessee river, would make this one of the grandest and most profitable railroad lines on the continent.

Even with the Western & Atlantic and Marietta & North Georgia connections and amicable traffic relations with the Georgia Pacific and Richmond & Danville at Atlanta, without the extension to Sheffield as contemplated, this line as a money-earning road would have few equals and absolutely no superiors.

It is then stated that this line, being the shortest between Atlanta and Savannah by 47 miles, may expect to take away one half the traffic of the Central of Georgia and East Tennessee, Virginia & Georgia roads and one third of that of the Georgia road "Making the gross income of this line per annum, from Atlanta to Savannah $2,475,110." We do not present the above as a model of careful and accurate work in the estimation of the cost and income of projected railways. $14,000 per mile for building a first class road and equipping it in a manner "never surpassed and seldom equalled by any new road," is a figure which is better calculated to attract unsophisticated investors than to serve as a guide to estimating engineers.

Nashville & Charleston.—Surveys are in progress on this road near Madisonville, Tenn.

Charleston & Gauley.—Incorporated by EDWARD B. KNIGHT and others of Charleston, W. Va., to build a railroad from Charleston to the Virginia State Line with several branches.

Decatur, Chesapeake & New Orleans.—Shelbyville, Tenn., will vote, Feb. 7, on the proposition to subscribe $35,000 in aid of this enterprise.

THE NORTHWEST.

Existing Roads.

Illinois Valley & Northern.—

LA SALLE, Ill., Jan 3, 1888.

EDITOR ENGINEERING NEWS:

Track was laid on this road during 1887 from Walnut Junction to C. B. & Q. R. R. Crossing, 14 miles; and from Kangley to Ticona, 12 miles. About 30 miles are under construction between ends of track. A 750 ft. 5 span iron bridge is to be built at La Salle. The substructure is two-thirds completed, and the iron work is finished ready for erection.

R. L. ENGLE, *Chief Engineer.*

Jacksonville & Southeastern.—It is proposed to extend the branch which now terminates at Driver's station, to Benton, Ill., about 20 miles.

Sault Ste. Marie & Atlantic.—

FAIRCHILD, WIS., Jan. 3, 1888.

EDITOR ENGINEERING NEWS:

Track was laid on our road in 1887 from Fairchild to Osseo, Wis., 14 miles. Extensions are now under survey from Osseo to Alma, Wis., 54 miles, and from Fairchild to Abbotsford, Wis., 50 miles. It is proposed to extend the line on the north to Rhinelander, Wis., and on the west to Omaha, Neb., making a total length of about 440 miles.

N. C. FOSTER, *President and General Manager.*

Winnipeg & Hudson Bay.—H. S. HOLT of the firm of Mann & Holt, who built the completed portion of this road, has taken possession of the line by virtue of a judgment in his favor of $21,000. He says that the road may be eventually extended to Grand Rapids, but it is very unlikely that it will ever be built to Hudson Bay.

St. Paul, Minneapolis & Manitoba.—A branch line is under consideration from St. Cloud, Minn., to Little Falls, 32 miles. Citizens of Little Falls are interested in the project, and will extend liberal aid to the new line.

Illinois Central.—It is stated that the Board of Trade of Pierre, Dak. will vote $100,000 aid to the company for their proposed extension from Sioux Falls west. It is stated that when the proposed extension in Nebraska is built, the Missouri river will be bridged at Sioux City instead of Decatur as was at first proposed.

New Projects and Surveys.

Mount Vernon & Paducah.—The line of this Illinois road is to extend from Mt. Vernon, Ill., to Paducah, Ky., a distance of 110 miles. Mr. AMASA MASON, who has charge of the company's office in this city at 120 Broadway, informs us that 66 miles, from Paducah to Cypress Junction, has been located and will be placed under contract at once. It is hoped to begin work on the northern section from Mt. Vernon to Cypress Junction before the close of next season. The branch to Eldorado is still problematical.

Quincy & Beardstown Short Line.—This company has been incorporated by Jos. H. CARTER of Quincy, Ill., and others, to build a railroad to Beardstown, a distance of about 50 miles. We presume this is merely a move of local capitalists toward forwarding the building of this extension, which the Ohio & Mississippi company has long been considering.

Lake Superior & Pacific.—

329 *West Superior St.*

DULUTH, Minn., Dec. 31, 1887.

EDITOR ENGINEERING NEWS:

The Lake Superior & Pacific Ry. is projected to run from Duluth to the Pacific ocean and surveys are now in progress in Minnesota. The maximum grade is ¾ of one per cent. Right of way is being obtained and capital for building the Minnesota division has been secured by a bond issue. J. R. MYERS is President.

W. B. SILVEY, *Chief Engineer.*

The map which Mr. SILVEY sends shows the Minnesota line extending direct from Duluth to Crookston, while the Pacific extension (the building of which, we venture to suggest may be rather a long way in the future), stretches out in an air line due west about half way between the Manitoba and the Northern Pacific.

Yankton, Sioux Falls & Nebraska.—

817 *Royal Insurance Building.*

CHICAGO, Ill., Dec. 31, 1887.

EDITOR ENGINEERING NEWS:

This company was organized and made a survey from Yankton to Sioux Falls, Dak., for the purpose of aiding "Manitoba" in extending from Sioux Falls to Yankton. The Manitoba is just completing its line from Willmar to Sioux Falls and is now surveying by its own engineers a line for an extension from Sioux Falls to Yankton, which will undoubtedly be built next spring. J. C. MCVAY of Yankton is President of the company, and M. T. WOOLEY of Yankton is Chief Engineer.

J. B. HARRIS, *Secretary.*

Canada, La Crosse & Southwestern.—One of the officers of this company informs us that foreign capital has been enelisted in the enterprise and that several hundred miles have been located in Wisconsin and Iowa and will be built during the coming season. Contractors or engineers wishing further information regarding this work may address the President, F. A. ROZIENE, care Mercantile Safe Deposit Co., New York City.

THE SOUTHWEST.

Existing Roads.

Chicago, Rock Island & Pacific.—The surveyors on the Texas extension are reported to have crossed the Red River and reached Wichita Falls. Reports from San Antonio state that Dr. J. O. KULP, of Davenport, Ia., representing the Rock Island company, offered before the Citizens' Association of San Antonio, Tex., to build the extension from Odessa, on the Texas Pacific, to San Antonio, about 300 miles, *provided* the San Antonians would give a bonus of $100,000 worth of city lots. Besides this little piece of railroad work, Dr. KULP proposes to build from Odessa north into the Panhandle to a connection with the southwestern extension of the Chicago, Kansas & Nebraska, which would make a total of at least 500 miles, all in the exceedingly dry region of western Texas. It is probable that, to say the least, Dr. KULP, or any one else, is not authorized to make this sort of offer on behalf of the Rock Island company. The report says: "The counties through which the road will pass will be asked to subscribe land instead of cash, and as Texans have much more land than anything else the road will doubtless be built." The statement regarding the relative abundance of land and other commodities in Texas is doubtless true, but we fear that circumstances will defeat the hopeful conclusion deduced from that fact.

Atchison, Topeka & Santa Fé.—Some pretty rapid railroad building was done recently under pressure of circumstances, in Ashland, Clarke county, Kan. The company had been voted $140,000 in bonds on condition that they had a depot building erected and trains running thereto by Jan. 1, 1888. The depot and line were completed some time ago, but it was found that the fact that the depot was located on the outskirts of the town on land which had been taken into the corporate limits since the subsidy was voted, would be urged to defeat the issue of the bonds. A force of men was brought on the ground at once, land was purchased in the heart of the city, and within four days a depot was built on it and track was laid thereto.

St. Louis & San Francisco.—The Kansas Midland road from Wichita to Ellsworth, Kan., 104 miles, has been completed.

Missouri.—The State Board of Railroad Commissioners issues the following statement of tracklaying in Missouri in 1887:

	Miles.
Atchison, Topeka & Santa Fé (St. Joseph extension)	20.4
Cape Girardeau S. Western (Brownwood Br.)	9.00
" (Main line)	3.5
Chicago, Milwaukee & St. Paul	128.3
Chicago, Santa Fé & California	194.00
Chicago, St. Paul & Kansas City	46.00
Current River (Willow Springs eastward)	35.00
Kansas City, Ft. Scott & Gulf (Belleville Br., Jasper Co)	3.00
Kansas City, Independence & Park	8.00
Kansas City Southern	10.00
Missouri Central	10.00
Missouri Pacific (Lexington, Booneville & Jeff. City)	41.00
Missouri Pacific (Kansas City & Western)	20.9
Missouri Pacific (St. Louis, Oak Hill & Carondelet)	6.3
St. Louis, Kansas City & Colorado	36.9
Springfield Connecting Track	2.72
Total track laid in 1887	575.02
Total mileage reported Dec. 31, 1886	5,088.24
Total mileage Dec. 31, 1887	5,663.26
Standard gauge	5,568.31
Narrow gauge	94.95
Total	5,663.26

Denison & Washita Valley.—Track has been laid on this road from Denison, Tex., to the Red River, 5 miles, and contracts for the bridge across the Red river and grading the line to the coal fields in Indian Teritory are to be let at once. At a stockholders' meeting held at Denison Jan. 6, JOHN SCULLIN, of St. Louis, was elected President, and H. L. V. PERRY, Secretary. Bonds are to be issued at a rate of not more than $18,000 per mile for building the road. W. B. MUNSON, of Denison, is General Manager.

Denison, Bonham & New Orleans.—Tracklaying is to be completed next month on the 8 miles from Denison to Bonham. S. B. ALLEN, of Bonham, is President, and FRED. P. JAMES, of Denison, is Chief Engineer.

New Projects and Surveys.

Fort Worth Western.—This Texas company has been reorganized, with W. W. H. LAWRENCE, of Fort Worth, as President. The road has been located for 200 miles, and $160,000 of local aid has been secured. The line is projected to Albuquerque, N. M. Work is to begin soon on the lines to the company's coal fields, in Jack and Young counties. M. O. HALL, of Fort Worth, is Chief Engineer.

Kansas City, Arkansas & New Orleans.—This company has been incorporated in Arkansas to build a railroad from Beebe, Ark., to Monroe, La., about 200 miles, with a branch line, 85 miles in length, running north from Monticello. GEO. M. BARBOUR, of Beebe, is interested.

Missouri Midland.—This is the title of a rumored project in Missouri, the line of which is to extend from Chillicothe to Marshall. J. T. JOHNSON of Chillicothe is interested.

Interstate & Denver.—

MARION, KAN., Jan. 6, 1888.

EDITOR ENGINEERING NEWS:

The Interstate & Denver Railroad will extend from Madison, Kan., to Denver, Col., and will be an extension of the Interstate Railroad from Butler, Mo., to Madison. It will probably be built next year as it is a *necessity* to the Interstate road. It will probably intersect the Missouri Pacific system at some point in Saline Co., Kan., through Cottonwood Falls and Marion, thence up the Cottonwood river valley to a point near Gypsum City in Saline Co. The project is in the Missouri Pacific interest. A. E. GODEFFROY, 146 Broadway, New York City, is President.

ALEX. E. CASE, *Secretary.*

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Mexican National.—About 7,000 hands are reported at work on the extension of this road to form a new through line to the city of Mexico. Surveys are also in progress from Lampasas west to a connection with the Mexican International, about 50 miles.

Mexican Central.—Work is being rapidly pushed on the Guadalajara and San Luis Potosi branches. The former is to be opened for business by May.

Southern Pacific.—This company completed 171 miles of extensions during 1887 in the State of California. The California & Oregon line was finished from McCloud to the Oregon State line, 69.6 miles, the coast line in southern California was extended 80 miles from Saugus to Santa Barbara, and its northern division was extended 17 miles to Templeton. The important extensions under way are the San Joaquin Valley line, 50 miles of which have been graded; the coast line, of which about 100 miles from Templeton to Santa Barbara remains to be constructed; the Santa Rosa & Carquinez, and the Shingle Springs and Placerville. Many other extensions are projected and under survey, and will be incinded in our map of that section.

Colorado.—*The Denver Republican* gives the following report of tracklaying for 1887 in the State of Colorado:

	Miles
Missouri Pacific	175
Colorado Midland	239
Denver & Rio Grande	157
Denver & Santa Fé (A. T. & S. F.)	147
Denver, Texas & Fort Worth	65
Total	783

The following is given as the work "promised" for 1888:

The Chicago & Rock Island, from some point in Southwestern Kansas to Colorado Springs, and also from St. Joseph, Missouri, straight westward to Denver.

The Chicago & Northwestern from Fremont, Nebraska, to Denver.

The Atchison, Topeka & Santa Fé from Albuquerque, New Mexico, northwestwardly through Southwestern Colorado, by way of Durango and on to Salt Lake City.

The Denver & Golden from Denver to the foot-hills.

The Colorado Midland westwardly through Garfield county and on to Salt Lake.

The Rio Grande, down the Grand to Grand Junction.

The Union Pacific from Ft. Steele, Wyoming, south to Meeker.

Denver & Rio Grande.—It is stated that a branch will be built this year to Lake City, Col.

Denver & Rio Grande.—A report from Denver states that surveyors are to begin work at once on the line of the recently incorporated Utah & Pacific. The route is to be from Glenwood Springs down Grand river and parallel with the Denver & Rio Grande Western to Salt Lake City and Ogden. A rumor of this sort needs considerable confirmation before it should be believed. The company is hardly in a condition to undertake an extension of such magnitude and difficulty through a country whose resources are still to be developed, and the amount of whose probable traffic is still a matter of uncertain guess work.

New Projects and Surveys.

Rio Grande & Utah.—This is the name of the projected line from Albuquerque, N. M., *via* Durango, Col., to Salt Lake City, Utah, which is popularly supposed to be backed by the Santa Fé. Press reports state that surveyors are at work on the line 60 miles north of Albuquerque under direction of BEN L. JONES, and that Gen. COOK, of Chicago, a director of the Santa Fé, is at the head of the enterprise and announces that work will begin in the spring and will be pushed through at once. We have referred before to the probable character of this enterprise: and in reference to the above item, it is noticeable that Gen. Cook's name does *not* appear in the list of directors of the Atchison, Topeka & Santa Fé.

Livingston & Castle Mountain.—This company has been incorporated in Montana to build a railroad between the points above named. As Hon. S. T. HAUSER, of Helena, is one of the incorporators, it is safe to assume that the line is another mining branch of the Northern Pacific.

Fresno City, Belmont & Yosemite.—It is stated that this recently organized California company has ordered rails, ties and rolling stock and let contracts for its road. WILLIAM R. THOMAS, Fresno City, Cal., is interested.

Russo Chinese Railways.—According to the Russian newspapers three great railways are to be constructed between Russia and China; one between Semipalatinsk and Shanghai, another between Chita and Pekin, and the third between Kiahita and Pekin. Negotiations for the same are now in progress.

Officers of New Southern Railroads now under Construction, Surveyed or Projected.

As a large number of inquiries have been sent us concerning the addresses of officers of the new Southern railway lines given in our list of Dec. 3, we devote some space this week to a list of principal officials of these roads, from whom further information may be obtained. The condensed statement of the new work in progress and proposed, was given in our issue of Dec. 3, and later information concerning them is contained in "Railroad News" of succeeding issues. The following list contains the officers of those companies only which are not given in "Poor's Directory of Railroad Officials." For officers of old companies who are building extensions, reference should be made to that book or to the "Official List," either of which will be mailed from this office on receipt of $2.00.

Virginia.

Craig Company's Railroad.—President C. G. Eddy, Vice President Norfolk & Western R. R. Co., Roanoke, Va.

Danville & Seaboard.—President, W. T. Sutherlin, Danville, Va.

Durham & Lynchburg.—President, Peter J. Otey, Lynchburg, Va. Chief Engineer, J. W. Goodwin, Lynchburg, Va.

Mineral.—Secretary, L. D. Scott, Alexandia, Va.

West Virginia.

Cumberland, Moorefield & Southwest Virginia.—Chief Engineer, J. P. Gaffney, Cumberland, Md.

Kingwood & Tunnelton.—Superintendent, Geo. W. Whitescarver, Grafton, W. Va.

Ripley & Mill Creek Valley.—Chief Engineer, A. J. Vosburgh, Jackson C. H., W. Va.

West Virginia.—Chief Engineer, Jonathan Barrett, Morgantown, W. Va.

Romney.—Secretary, Isaac W. Brady, Kingwood, W. Va.

North Carolina.

Albemarle & Pantego.—Chief Engineer, H. T. Greenleaf, Edenton, N. C., care steamer *Haven Belle*.

Clarkeville, Blue Wing & Durham.—President, W. L. Holt, Blue Wing, N. C. Secretary, O. R. Smith, Durham, N. C.

Murfreesboro.—President, B. B. Winborne, Murfreesboro, N. C.

Roanoke & Southern.—President, D. T. Houston, Roanoke, Va. Chief Engineer, E. F. Fuller, Roanoke, Va.

Roanoke Railroad & Lumber Co.—Chief Engineer and General Manager, S. F. Burbank, Plymouth, N. C.

Southern & Western Air Line.—President, S. McD. Tate, Morgantown, N. C. Chief Engineer, J. N. Wilson, Morgantown, N. C.

Wilmington, Onslow & East Carolina.—President, Daniel L. Russell, Wilmington, N. C. Secretary, Eugene Martin, Wilmington, N. C.

Wilmington Sea Coast.—President, William Latimer, Wilmington, N. C. Secretary, Iredell Meares, Wilmington, N. C.

South Carolina.

Blackville, Newberry & Alston.—President, Geo. A. Wagener, Charleston, S. C.

Carolina, Cumberland & Chicago.—President, R. E. Bower, Briggs, S. C. Chief Engineer, R. J. Kirk, Hodges, S. C.

Carolina, Knoxville & Western.—President, W. L. Mauldin, Greenville, S. C.

Columbia, Newberry & Laurens.—President, H. C. Mozeley, Prosperity, S. C. Chief Engineer, Chas. Ellis, Jr., Prosperity, S. C.

Eastern, Barnwell & Western.—Secretary, W. H. Duncan, Charleston, S. C.

Orangeburgh & Lewiedale.—Chief Engineer, H. T. Peake, Vances, S. C.

Georgia.

Athens & Jefferson.—Chief Engineer, D. C. Barrow, Athens University, Athens, Ga.

Atlanta & Alabama.—Secretary, L. E. O'Keefe, 69 Forest Ave., Atlanta, Ga.

Atlanta & Florida.—Chief Engineer, H. L. Collier, 42½ East Alabama St., Atlanta, Ga.

Atlantic, Atlanta & Great Western.—President, Geo. T. Fry, Atlanta, Ga.

Atlantic, Birmingham & Western.—Vice President, W. J. Weeks, Talbotton, Ga. Chief Engineer, R. L. Hunter, Talbotton, Ga.

Birmingham & Atlantic Air Line.—President, Douglas Green, care Green & Bateman, New York City. General Manager, Jno. A. A. West, Roanoke, Ala.

Blue Ridge & Atlantic.—President, W. B. Thomas, Athens, Ga.

Buena Vista & Ellaville.—President, W. B. Harold, Americus, Ga. Chief Engineer, Edwin F. Jones, Americus, Ga.

Chattahoochee Valley.—President, L. Lanier, West Point, Ga.

Chattanooga, Rome & Columbus.—President, J. D. Williamson, Rome, Ga. Chief Engineer, F. A. Harris, Rome, Ga.

Darien Short Line.—President, R. H. Walker, Darien, Ga.

Georgia, Carolina & Northern.—President, R. F. Hoke, Raleigh, N. C. Chief Engineer, J. D. Morrison, Athens, Ga.

Georgia Southern & Florida.—General Manager, J. Lane, Macon, Ga. Chief Engineer, W. S. Greene, Columbus, Ga.

Hawkinsville & Western.—Secretary, R. G. Lewis, Hawkinsville, Ga.

Lexington Terminal.—Secretary, Hamilton Mc Whirter, Lexington, Ga.

New Life Water Power & Granite.—President, Wm. T. Peck, Monroe, Ga.

Rome & Decatur.—Receiver, Rufus, T. Dorsey, Atlanta, Ga. Division Engineer, S. Z. Ruff, Rome, Ga.

Savannah & Tybee.—Engineer and Superintendent, Chas. D. Haines, Savannah, Ga.

Washington & Elberton.—President, T. B. Green, Washington, Ga. Chief Engineer, R. T. Barksdale, Washington, Ga.

Wrightsville & Tenille.—President, W. B. Thomas, Athens, Ga.

Florida.

Alabama, Florida & Atlantic.—President, J. C. Graff, New York City. Chief Engineer, J. O. Fries, Orlando, Fla.

Canaveral & South Florida.—Secretary, D. P. Wesson, Canaveral, Fla.

Gainesville, Tallahassee & Western.—President, Albert L. Rice, New York City. Chief Engineer, M. F. Miller, Gainesville, Fla

Jacksonville, Mayport & Pablo.—Secretary, A. Wallace, Jacksonville, Fla.

Orlando & Winter Park.—Chief Engineer, J. H. Abbott, Box 222, Orlando, Fla.

Palatka, Welaka & Lake.—President, Sherman Conant, Jacksonville, Fla. Chief Engineer, C. R. Knight, Jacksonville, Fla.

Pierson, Kenwood & Palmetto.—General Manager, N. L. Pierson, Pierson, Fla. Chief Engineer, Peter Strand, Pierson, Fla

St. Augustine & East Coast.—Chief Engineer, Wm. Mickler, St. Augustine, Fla.

St. John's River.—President, W. T. Sylvester, Jacksonville, Fla. Chief Engineer, S. B. Carter, Palatka, Fla.

Suwanee & Gulf.—Secretary, Jas. O. Andrews, Cedar Keys, Fla. Chief Engineer, D. B. Dunn, Cedar Keys, Florida.

Tavares, Apopka & Gulf.—General Superintendent, W. B. Tucker, Tavares, Fla.

Alabama.

Alabama Great Northwestern.—Secretary, E. B. Joseph, Montgomery, Ala.

Alabama Midland.—President, O. C. Wiley, Troy, Ala. Chief Engineer, Arthur Pou, Talbotton, Ga.

Anniston & Cincinnati.—Address Alfred L. Tyler, Anniston, Ala., President Anniston & Atlantic R. R., or Thos. K. Scott, Anniston, Ala., Superintendent, A. & A. R. R.

Birmingham, Georgia & Florida—President and Acting Chief Engineer, J. A. Montgomery, Box 734, Birmingham, Ala.

Birmingham, Mobile & Navy Cove Harbor. General Manager, Thaddeus McNulta, Mobile, Ala.

Cincinnati, Huntsville & Birmingham.—President M. R. Campbell, Tullahoma, Tenn. Secretary, B. P. Hunt Huntsville, Ala.

Dauphin Island.—Vice President and Secretary, Henry E. Fanshawe, Mobile, Ala. Chief Engineer, Geo. Leighton, Mobile, Ala.

Decatur, Chesapeake & New Orleans.—President G. C. Sandusky, Shelbyville, Tenn. Chief Engineer, Josiah Flournoy, Decatur, Ala.

Eufaula & St. Andrews Bay Air Line.—President, Col. W. N. Reeves, Eufaula, Ala.

Florence & Chicago.—President, W. B. Wood, Florence, Ala., Chief Engineer, Chas. Boechk, Florence, Ala.

Florence, Tuscaloosa & Montgomery.—President, W. B. Wood, Florence, Ala. Chief Engineer Belton Mickle, Sheffield, Ala.

Gulf & Chicago.—Chief Engineer, S. D. Brown, Mobile, Ala.

Isbell & Iron Mountain.—Secretary, John E. Isbell, Russellville, Ala.

Macon & Tuscaloosa.—President, R. C. Patty, Macon Miss.

Mobile & Birmingham.—President, J. G. Bush, Mobile, Ala. Chief Engineer, Carey A. Wilson, Mobile, Ala.

Montgomery, Hayneville & Camden.—Chief Engineer, C. P. Rogers, Letohatchee, Ala., Secretary, W. Brewer, Hayneville, Ala.

Pensacola & Memphis.—President, W. W. Hungerford, Meridian, Miss. Chief Engineer, J. W. Gallup, Meridian Miss.

Selma & Cahaba Valley.—President, R. M. Nelson Selma, Ala.

Sheffield & Seaboard.—President, Alfred H. Moses, Sheffield, Ala. Chief Engineer, Belton Mickle, Sheffield, Ala.

Tuscaloosa Northern.—Chief Engineer, R. C. McCalla Tuscaloosa, Ala.

Mississippi.

Corinth & Tennessee River.—President, C. B. Howery, Oxford, Miss. Chief Engineer, John B. Inman, Troy, Tenn.

Mobile, Hattiesburgh & Jackson.—President, John Kemper, Enterprise, Miss. Chief Engineer, S. D. Brown, Mobile, Ala.

Tombigbee.—President, B. A. Vaughn, Columbus, Miss. Chief Engineer, W. J. Kelly, Columbus, Miss.

Warrior Coal Fields.—Chief Engineer, J. W. Gallup, Meridian, Miss.

Tennessee.

Chattanooga, Hiawassee & Augusta.—President, Henry E. Colton, Murphy, N. C. Chief Engineer, J. A. Kelley, Murphy, N. C.

Danville & La Grange.—D. P. Wrenne, Superintendent La Grange Furnace Co., Stribling, Tenn.

Humboldt & Dyersburg.—Address John B. Inman, Chief Engineer Corinth & Tennessee River, Troy, Tenn.

Knoxville Southern.—President, R. M. Pulsifer, Boston, Mass. Secretary, A. A. Arthur, Knoxville, Tenn.

Lookout Mountain.—President, C. E. James, Chattanooga, Tenn.

Nashville & Knoxville.—President, A. L. Crawford, Nashville, Tenn.

Nashville & Tellico.—Chief Engineer, W. G. Sears, Athens, Tenn.

Powell's Valley.—General Manager, A. A. Arthur, Knoxville, Tenn. Chief Engineer, J. W. Wilson, Knoxville, Tenn.

Tennessee Midland.—President, A. S. Buford, Memphis, Tenn. Chief Engineer, R. H. Temple, Cotton Exchange Building, Memphis, Tenn.

Troy & Tiptonville.—President, Geo. B. Wilson, Troy, Tenn. Chief Engineer, John B. Inman, Troy, Tenn.

Kentucky.

Cairo & Tennessee River.—President, B. A. Neal, Mayfield, Ky.

Elizabethtown & Hodgenville.—Chief Engineer, J. W. Robinette, Elizabethtown, Ky.

Louisville, Cincinnati & Virginia.—President, J. L. Robertson, 7 Nassau St., New York City. Chief Engineer, J. C. Turner, Manchester, Ky.

Louisville, St. Louis & Texas.—President, J. C. Fawcett, Louisville, Ky. Chief Engineer, W. M. Patton, Louisville, Ky.

Louisville Southern.—President, J. W. Stine, Louisville, Ky. Chief Engineer, John McLeod, Louisville Ky.

Madison & Southeastern.—President, Wm. Cravens, New Castle, Ky.

Marion, Princeton & Ohio River.—President, R. W. Wilson, Marion, Ky. Secretary, John W. Blue, Marion, Ky.

Owensboro, Falls of Rough & Green River.—President A. C. Tompkins, Owensboro, Ky.

Paris, Frankfort & Georgetown.—President, Wm. Lindsay, Frankfort, Ky.